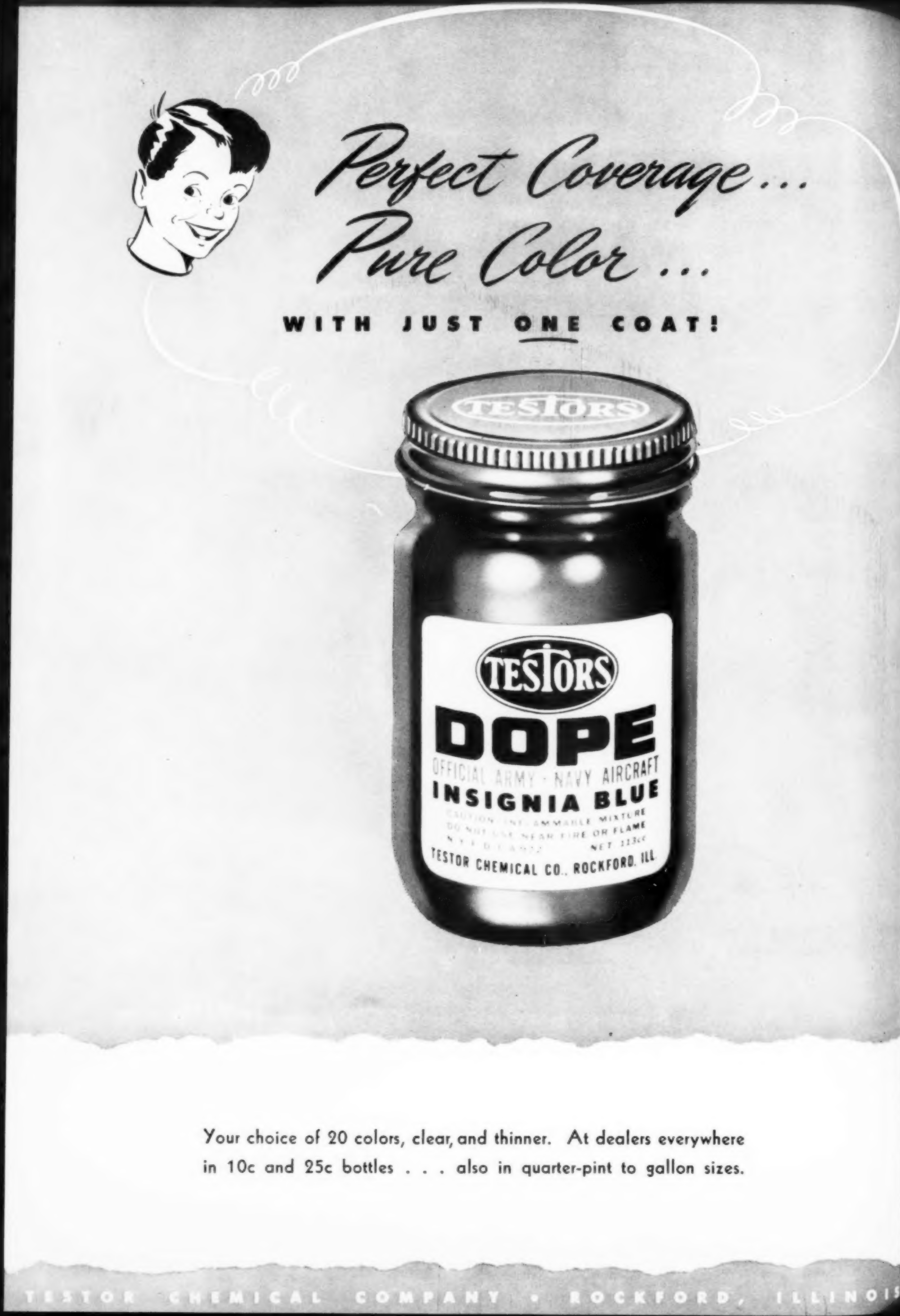
# MODEL AIRPLANE NEWS

SEPTEMBER 1947 • 25¢

GRUMMAN MALLARD

**SOME OF THE FEATURES IN THIS ISSUE**

Exact Scale Control Line "Ercoupe"
Helicopter Principles
Wylam Masterplans: Pfalz D-3
Design Your Propellers Correctly
Advanced Radio Control
Flying Scale Albatros DXI
Realistic Flying Helicopter Model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# MODEL AIRPLANE NEWS

JAY P. CLEVELAND
Publisher

*Serving Aviation 19 Years*

SEPTEMBER 1947 VOL. XXXVII No. 3

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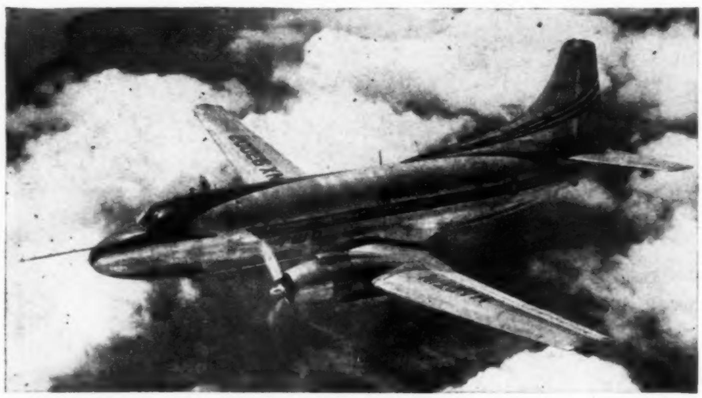
THE WORLD'S speed record has come home to the United States at last. A special Lockheed P-80R averaged 623.8 mph to set up the new mark, which may stand for a considerably longer time for conventional airplanes than many are guessing now. The new Lockheed is considerably different aerodynamically from the combat P-80's now in service. Changes include new "flush" air inlets and a new laminar flow wing much thinner than that used previously. Both these changes reduce drag of the P-80R considerably, but a major contribution to the record was made by the new Allison Model 400 turbojet engine. The Model 400 produces 4600 lbs. of static thrust which, at the speed the P-80R was flying, was nearly 9000 equivalent hp (3 P&W *Wasp Majors*)! The new engine weighs 1735 lbs., which is equivalent of about *one-fifth* of a pound per horsepower!

PRODUCTION ON the monster Consolidated Vultee B-36A is well along at the Fort Worth (Tex.) Division on a contract for 100, reported in this column months ago. The B-36A is considerably different than the original XB-36 with major differences centering in the 4-wheel main gear units and a redesigned nose compartment including a bubble canopy. The new gear will permit the 160-ton monsters to operate from any field capable of sustaining Boeing B-29 operations, rather than the 3 from which the single-wheel XB-36 can operate. Armament of the B-36A may now be revealed as including 8 remotely-controlled turrets mounting twin 20-mm cannon! In addition, "parasite" fighters may be carried in the tremendous bomb bays for high-altitude defense measures. Although the B-36A range is "only" 10,000 miles, Air Staff planning groups are giving thorough consideration to its use as a "shuttle" bomber, permitting operations from the U.S. over a target to a friendly base with a return trip after fueling.

THE WARTIME secret of Muroc Army Air Base was recently revealed to a visiting group of aviation writers, of which your *Flash* reporter was one. What he saw was impressive to be sure, but equally as "impressive" was the fact (*Turn to page* 52)



(Above) The Martin 2-0-2 now undergoing final CAA certification tests after increase in fin area and addition of considerable wing dihedral.

(Below) This Fokker 4 place plane won first prize in its class at Paris International Air Show

*Model Airplane*

# NEWSLETTER

by AL LEWIS

THIS month our dissertation is devoted almost exclusively to control line flying—past, present and future.

But first we want to present an extremely nice bit of verse written for the recent 18th Annual New England Championship Model Airplane Contest held in Boston, Mass. Up there, the Jordan Marsh-Boston Traveler Junior Aviation League has been holding its annual indoor-outdoor invitation meet for almost two decades. That's a long time in the model aviation sport. Each year the League offers 20 to 30 trophies, plus motors and merchandise to the best flyers in indoor microfilm classes, indoor scale models, outdoor rubber and free flight gas events.

Historian for the J.A.L. is Mrs. William Phillips of Belmont, Mass. Her son, Hewitt, was the League's second member to attain the rating of "ace" (in a dozen and a half years about 12 members have made that grade from a membership of many thousands!). "Hew" is now in charge of the stability test section at NACA's labs in Langley Field, Va., and away from Junior Aviation League activities, but his mother still retains her interest and maintains a complete historic library on the J.A.L. and the accomplishments of its members, both as modelers and members of the full scale aviation industry and AAF.

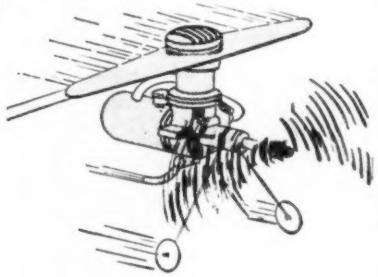
To top off her remarks at the Jordan-Traveler annual "banquet" attended by 100 of the champion eastern flyers, she searched for a poem to express her feelings of what model plane building and flying does for the younger enthusiats. Finding nothing, she sat down and dashed off this, which we consider extremely apropos:

BOY'S HOBBIES

*To have a task*
*is all I ask*
*Just something to be done*
*to train my hands*
*And mind and heart*
*from dawn to setting sun.*

*Just tools or paper—*
*simple things*
*To occupy my time*
*then when I grow to man's estate*
*My life will be worthwhile.*

AS PROMISED previously, we now unveil the super-control line model, latest design from the feverish brain of Aubrey (Red) Kochman of New York City. You'll



note it does away with the conventional fuselage, stabilizer, rudder, control mechanism, and numerous other hithertofore-considered-necessary parts. Red's idea is to put out an engine with one super cooling fin to which you attach your guide lines. Landing gear goes around the crankcase, and you're off!

ON THE EXTREMELY serious side we

(*Turn to page 57*)

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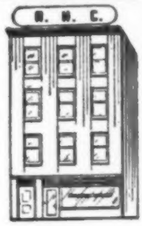


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| Forster 29 | (CL B) | 19.50 |
| Hurricane | (CL B) | 19.75 |
| Melcraft | (CL B) | 18.50 |
| Merlin | (CL B) | 18.00 |
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| Torpedo | (CL B) | 18.50 |
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| Pacemaker | (CL C) | 24.95 |
| OK 29 | (CL B) | 18.50 |
| OK Twin | (CL C) | 55.00 |
| Super Champion | (CL C) | 23.50 |
| Atwood Champion | (CL C) | 18.00 |
| Atom | (CL A) | 15.50 |
| Arden .099BB | (CL A) | 19.50 |
| Arden .199BB | (CL A) | 21.50 |
| Vivell 49 | (CL C) | 20.00 |
| Perky | (CL A) | 18.00 |
| Contester | (CL C) | 28.50 |
| Fleetwind | (CL C) | 24.75 |
| Ken | (CL C) | 32.50 |
| McCoy | (CL C) | 35.00 |
| Minijet | (Jet) | 35.00 |
| Hornet | (CL C) | 35.00 |
| Movo Diesel | (CL A) | 21.50 |
| Wensen | (CL B) | 20.00 |
| Hurleman | (CL C) | 20.00 |
| Madewell | (CL C) | 18.00 |
| Drone Diesel | (CL B) | 21.50 |
| Mite Diesel | (CL A) | 18.95 |
| McCoy 49 | (CL B) | 25.00 |
| OK 60 Race | (CL C) | 26.00 |
| Forster 99 | | 24.75 |

*No Premiums on Price-Fixed Items*

### MOTORS
(No Premiums)

| | | |
|---|---|---|
| Genie 29 | (CL B) | 6.95 |
| Rogers Ram | (CL B) | 9.95 |
| G.H.Q. | (CL C) | 15.00 |
| New Thor | (CL B) | 9.95* |
| New Thor Kit | (CL B) | 6.95 |
| Ohlsson 19 | (CL A) | 9.95 |
| Ohlsson 23 | (CL B) | 9.95 |

*Includes coil and condenser

## MOTOR ACCESSORIES

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|---|---|
| Battery Box (all sizes) | $ .40 |
| Megow Plastic (pen. or med.) | .40 |
| Aero Coil (Featherweight) | 2.50 |
| Aero Coil (Quality) | 3.00 |
| Smith Competitor Coil | 1.95 |
| Arden Coil | 2.50 |
| Winston Coil | 2.00 |
| Wilco Coil | 1.95 |
| Regular Coil | 1.50 |
| Metal Condenser | .45 |
| Paper Condenser | .20 |
| Ignition Wire (6 feet) | .25 |
| High Tension Lead Wire | .15 |
| Spark Plugs (all sizes) | .50 |
| Arden Booster Jack | 1.25 |
| Switch | .25 |
| Alligator Clips | .10 |
| Vitamite Wet Cell | 2.35 |
| Power-plus | |
| Flight Battery | 2.75 |
| Booster Battery | 3.50 |
| House Charger | 4.45 |
| Auto Charger | 1.95 |
| Arden Flight Timer | 1.85 |
| Austin Flight Timer | 1.50 |
| Comet Flight Timer | 1.00 |
| Hillcrest Flight Timer | 1.25 |
| Universal Needle Valve | .75 |
| 4-Way Plug Wrench | .15 |
| Neoprene Tubing (per ft.) | .50 |
| Spinit Starter | 5.00 |
| Aluminum Engine Mounts | .50 |
| Flo-Torque Props (8" to 14") | .50 |
| (16", 18") | 1.00 |
| Hi-Ball 9", 10", 11", 12" | .50 |
| Topping 10" Multi-pitch Prop | 1.50 |
| Topping 12" Multi-pitch Prop | 1.75 |
| Comet Props: 9", 10", 11" | .35 |
| 12" | .40 |
| Hi-Pitch Props: 8", 9", 10", 45c; 11", 50c; 12", 13", 60c; 14", 65c. | |
| Snafu Plastic Prop 10" | .75 |
| 12" | .90 |
| Topping 3 Blade Plastic Props | 1.50 |
| Sponge Rubber Wheels 2", 40c; 2 1/2", 50c; 3 1/2", 60c | |
| Trexler Balloon Wheels 2 1/2" 60c; 2 3/4" $1.00; 3" $1.25; 3 1/2" $1.50; 4 1/2" $1.75. | |
| Spray Gun | 1.25 & 1.75 |
| Modelers Plane | .75 |
| Flywheels A or B, $1.00; C, $1.50 | |
| Univ. Running Stand | 1.25 |
| Midget Screw Driver | .10 |
| Hi-Tension End Clips, each | .05 |
| Tip Jacks Set | .60 |
| Jem Pump Can | .75 |
| Plug Gauge Set | .15 |
| Alum. Prop Spinners 5/8", 20c; 3/4", 30c; 7/8", 75c; 1 1/2", $1.00; 2", $1.25; 2 1/2", $1.50; 2 3/4", $1.75. | |
| Presto Disc Starter | .25 |
| Bamboo paper—white, green, blue, each | .10 |
| Wood Stripper | .25 |
| Celluloid Sheet | .10 |
| Austin Tank | .50 |
| Froom Gas Tank | 1.00 |
| Winston Tank | .75 |

## FREE FLIGHT PLANES
(FREE: See item 9 above)

### For "A" & "B" Motors

| | |
|---|---|
| Coronet 46" | $2.50 |
| Buccaneer 48" | 3.50 |
| Buccaneer 36" | 1.50 |
| Bee 40" | 1.95 |
| Brooklyn Dodger 56" | 3.95 |
| Pacer B 53" | 3.95 |
| Topper 41" | 3.50 |
| Roamer 45" | 2.95 |
| Zombie 44" | 2.50 |
| Rocketeer 40" | 2.95 |
| Playboy Jr. 55" | 3.25 |
| Buccaneer B Spl. 54" | 3.95 |
| Jiffy 36" | 1.50 |
| Stratos 42" | 2.95 |
| Amer. Ace 54" | 3.95 |
| Banshee 50" DeLuxe | 6.95 |
| Banshee Std. 50" | 2.00 |
| Wanderer 54" | 3.50 |
| Bay Ridge Mike 48" | 2.00 |
| Zipper 54" | 5.95 |
| Runt 44" | 2.50 |
| Air Foiler 44" | 3.95 |
| Zoomer 60" | 6.95 |
| Musketeer 54" | 3.50 |
| Amer. Ace 36" | 1.50 |
| Stanzel Interceptor 51" | 2.98 |
| Skyrocket 36" | 2.95 |
| Ranger 46" | 2.50 |
| Comet Interceptor 42" | 3.95 |
| Musketeer 42" | 2.50 |
| Brigadier 58" | 2.95 |
| Brigadier 38" | 1.95 |
| Aero Champ 48" | 2.00 |
| Yogi 42" | 3.95 |
| Piper Cub Coupe 40" | 1.95 |
| Jersey Javelin 48" | 3.95 |
| Larkey 50" | 3.50 |
| Mercury Jr. 50" | 3.95 |
| Good News 50" | 3.95 |
| Powerhouse 56" | 4.95 |
| Strato Streak 40" | 2.50 |
| Spearhead Jr. 44" | 1.95 |
| Megow Piper Cub 53" | 4.50 |
| Ensign 50" | 3.50 |
| Crusader 48" | 7.50 |
| Baby Quaker 35" | 2.00 |
| Humdinger 52" | 3.95 |
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### For "C" Motors

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| Pacer "C" 60" | 4.95 |
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| Buccaneer C. Spl. 72" | 6.95 |
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| Skybo 66" | 6.95 |
| Super Quaker 76" | 7.00 |
| Sky Buggy Biplane 42" | 5.95 |

## CONTROL-LINE PLANES
(FREE: See item 9 above)

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|---|---|
| Capitol Ercoupe 40" B-C | $ 7.50 |
| Duraplane 26" B-C | 12.50 |
| Topping 21" B-C | 10.00 |
| Snafu Ercoupe 45" C | 12.50 |
| Fireball 36" B-C | 10.00 |
| Perky 18" A | 2.00 |
| Streamliner 25" B | 4.00 |
| Aero Puppet 24" B-C | 5.95 |
| Controliners by Berkeley | |
| P47 41" C | 5.95 |
| P51 37" A-B | 7.95 |
| Bat 32" C | 4.95 |
| Bug 17" A | 2.95 |
| Tiger Shark 36" C | 4.95 |
| Strato-Kitten 24" A-B | 2.95 |
| Super V Shark 24" B-C | 4.95 |
| Tarpon 28" B-C | 10.75 |
| P.D.Q. 24" A-B | 5.00 |
| Piper Skycycle 30" B-C | 7.50 |
| Falcon Speedster 25" B-C | 5.45 |
| Tether Streak 22" C | 3.50 |
| Dreamer 20" B-C | 7.50 |
| Vee-Gee 18" B-C | 10.00 |
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| Competitor 26" C | 5.50 |
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| Cadet 33" A-B | 5.45 |
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| Atomic 14 1/2" B | 3.50 |
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| Presto-Liner 20" A-B | 5.95 |
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| Model Aircraft Hand Book | 2.50 |
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## GAS BOATS

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| Sea Bird 24" B-C | 4.95 |
| Marlin 26" C | 7.50 |
| Reuhl 26" B-C | 15.00 |
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| Univ. Couplings 1/8" or 3/16" | 1.25 |
| Shafting 1/16", 1/8", 3/16", 1/4", 5/16", ft. | .25 |

Props: 2 Bladed: 2 1/2" .50, 3 1/2" .60
3 Bladed: 3/4" .45, 1" .45, 1 1/4" .50, 1 1/2" .60, 2" .80.

## RADIO CONTROL

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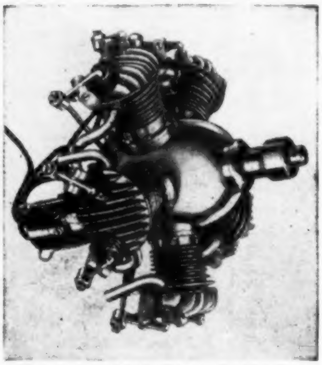

**Burgess M-5 Five Cylinder Airplane Engine**

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| M-5 Die cast Ring Mount | 3.75 |

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|---|---|
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| Drill Press, drill chuck | 6.95 |
| Shaper, blade, rubber belt | 7.95 |
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| Blades for Circular Saw, Combination rip and cross cut 4" | .75 |
| Blades for Jointer, 4", case hardened, per pair | 1.00 |
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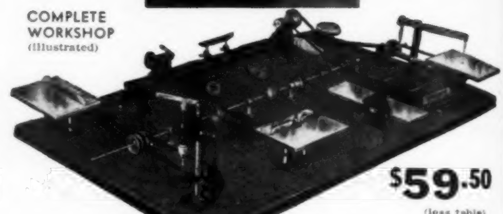
| Sand paper discs, for sander 6" dia., per doz. | .60 |
| Collars, for line shaft, per pair | .30 |
| Face Plate for lathe, 4½" swing | .75 |
| Grinding Wheel 3" dia. | .90 |
| Hangers for line shaft, 3 for | 1.00 |
| Line Shaft Sections 30" long, ⅜" dia. | .30 |
| Chuck for Drill Press, spring action tool steel jaws. For any drill round or square shank up to ¼" dia. | 1.00 |
| Pulley, die cast, 2½ O.D., with set screw | .50 |

COMPLETE WORKSHOP
(Illustrated)



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(less table)

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Includes Jig Saw, Circular Saw, Drill Press, Lathe, 1 Line Shaft, 2 Collars, 3 Hangers, 5 Pulleys, 5 Rubber Belts **$34.30**

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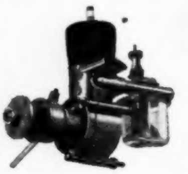
Motor not included. 1/10 to ¼ H.P. Motor will operate any set or individual tool.



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| | Class | |
|---|---|---|
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| *Herkimer OK29 | B | 18.50 |
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| K & B Torpedo | B | 18.50 |
| Madewell | C | 18.00 |
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| McCoy 49 | C | 25.00 |
| McCoy MCC-A | C | 35.00 |
| McCoy MCC-R | C | 35.00 |
| Rogers Ram | B | 9.95 |
| Vivell 35 | C | 18.00 |
| Vivell 49 | C | 20.00 |
| *Wensen | C | 20.00 |

*Includes Coil and Condenser.


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| Cannon 358 | C | 21.50 | 13.50 | *Rogers 29 | B | 15.75 | 9.95 |
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*Includes Coil and Condenser

**ACCESSORIES**

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| Wilco Coil | 1.95 | Control Braided, 150 ft. | 3.25 |
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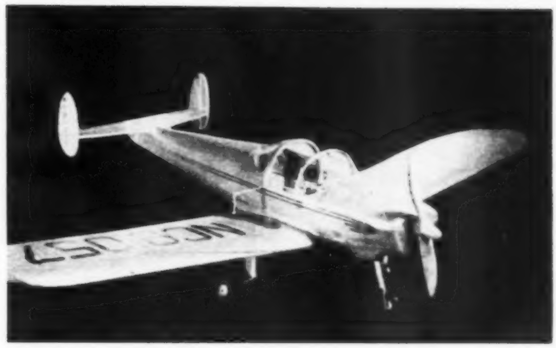
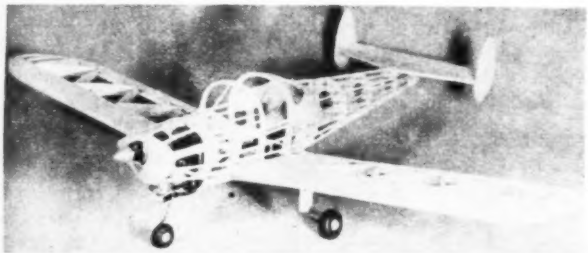
# ACE MODEL AIRPLANE COMPANY

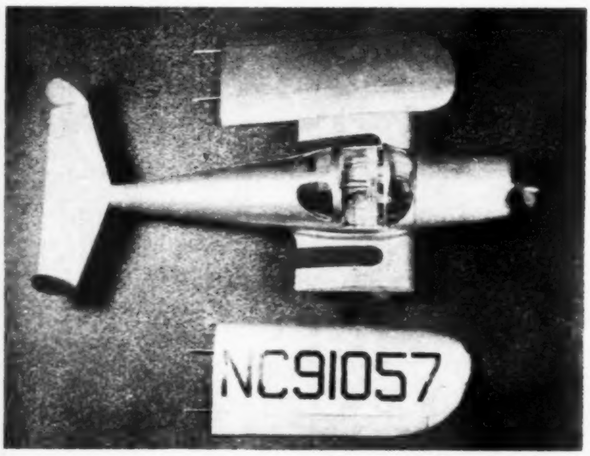
**3149 SHENANDOAH, ST. LOUIS 4, MO.**

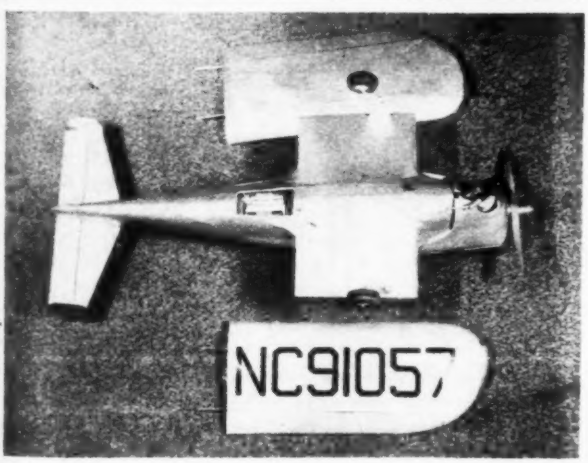
# MINIATURE ERCOUPE

by MORRIS MOUNTJOY








## This model is exact scale, even to the form of wing construction

IN designing the *Ercoupe* light plane, many unusual features were incorporated which have given private aviation an improved safety record and a greatly increased utility value.

Among the advantages of this new kind of airplane is the feature of coordinated aileron, rudder, and nose wheel controls, resulting in the complete elimination of rudder pedals and automobile type steering while taxiing. Expensive flight training and practice is therefore cut to a minimum, and the result is an airplane that is not only simple and easy to fly, but quick to learn to fly.

Another major innovation has been the disposition of propeller torque by canting the engine 3½ degrees to the right and using twin rudders, spread apart, to keep them away from the whirl of the slipstream. Stall characteristics have been improved and the *Ercoupe* has been rendered spinproof by the addition of 5° downward thrust of the engine, limiting the elevator upward travel, and by designing a special fillet which prevents the wing from stalling at its outer or tip portions.

Because of the stability which has been built into the full size *Ercoupe* it has been possible to reproduce a model to exact scale. The dihedral is especially advantageous with a high angle of 7° and is even sufficient for free flight. You will appreciate the nose wheel as a saver of propellers and also sparkplugs since the engine is inverted.

Begin construction by cutting the fuselage bulkheads from ⅛" medium balsa sheet. Make certain the ⅛" x ¼" holes for the main spars are all in line before glueing in position on the spars. Use a small triangle or a square object to make certain the bulkheads are in line and true.

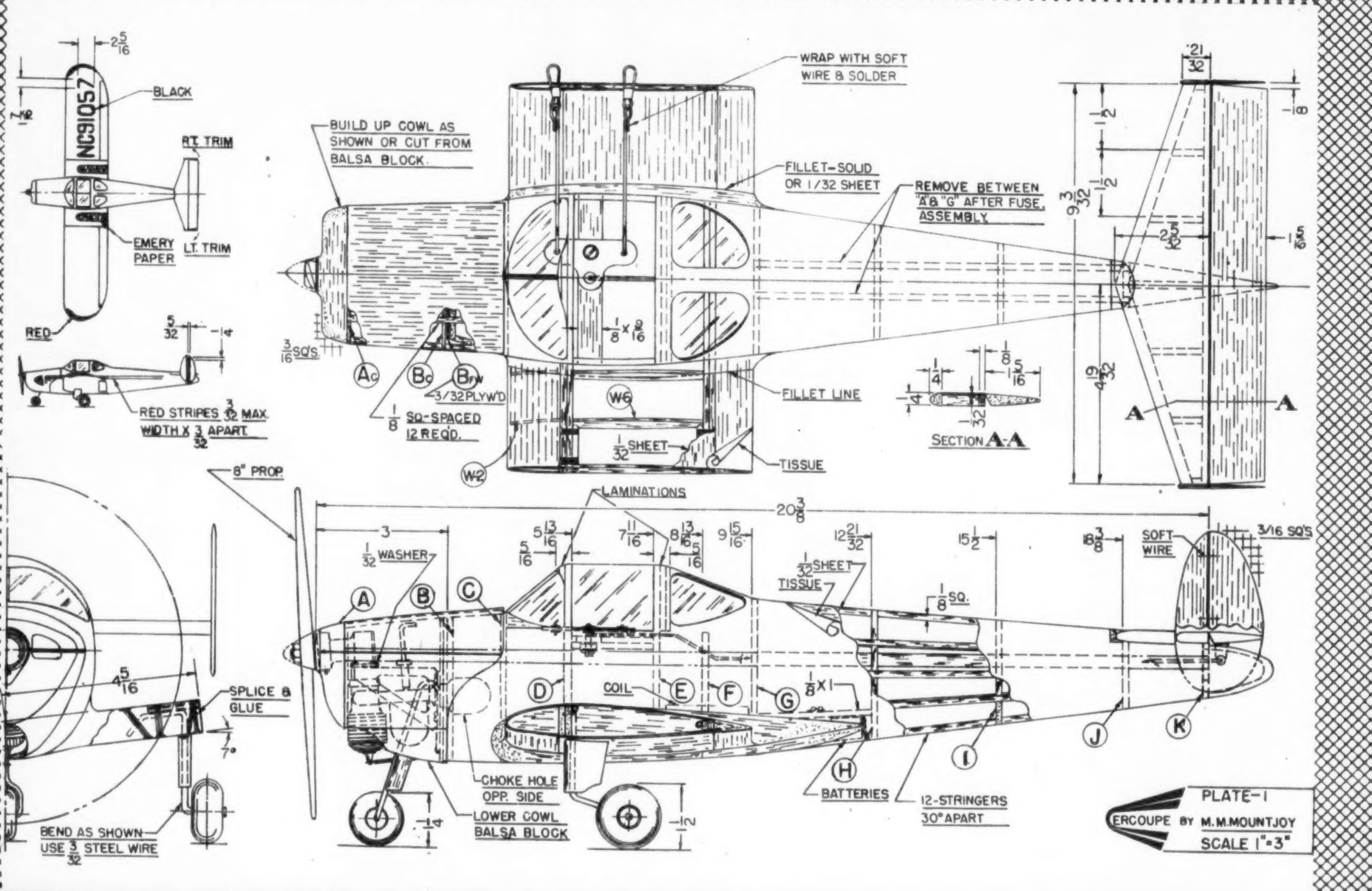
Stringers are laid on after the bulkheads are secured, and may be made from either ⅛" sq. or 1/16" x ⅛" medium hard balsa. If the 1/16" x ⅛" stringers are used they may be laid about 15° apart thus assuring a full curve and no flat spots when the 1/32" sheet covering is applied.

Now cut front and rear spars for the wing centersection from ⅛" medium balsa and glue in place on frames D and F. Dihedral is formed by cutting these spars from sheet wood and using a protractor to incorporate the 7° upward slant. The 7° dihedral should line up correctly with the vertical centerline of the bulkheads in order that alignment between fuselage and wings may be exact.

Centersection ribs are clearly outlined on the drawing; however, before assembling them it is desirable first to fasten the main landing gear and the wing mount tubes. Notch the wing spars where necessary when splicing these units in place with thread. This prevents any high spots when the 1/32" sheet covering is applied.

The fuselage structure complete, you are now ready to mount the nose wheel and motor. The nose wheel strut is bent from 1/32" dia. steel wire and spliced with soft wire or bolted to the firewall. If wire splicing is

(*Turn to page 46*)



WRAP WITH SOFT WIRE & SOLDER
BUILD UP COWL AS SHOWN OR CUT FROM BALSA BLOCK.
FILLET-SOLID OR 1/32 SHEET
REMOVE BETWEEN "A & "G" AFTER FUSE. ASSEMBLY
BLACK
NC91057
RT. TRIM
LT. TRIM
EMERY PAPER
RED
RED STRIPES 3/32 MAX. WIDTH X 3/32 APART
1/8 SQ-SPACED 12 REQD.
3/32 PLYW'D
3/16 SQ'S.
FILLET LINE
1/32 SHEET
TISSUE
SECTION A-A
8" PROP.
LAMINATIONS
1/32 WASHER
SOFT WIRE
3/16 SQ'S
1/32 SHEET
TISSUE
1/8 SQ.
COIL
1/8 X 1
SPLICE & GLUE
CHOKE HOLE OPP. SIDE
LOWER COWL BALSA BLOCK
BATTERIES
12-STRINGERS 30° APART
BEND AS SHOWN USE 3/32 STEEL WIRE
PLATE-1
ERCOUPE BY M.M.MOUNTJOY
SCALE 1"=3"

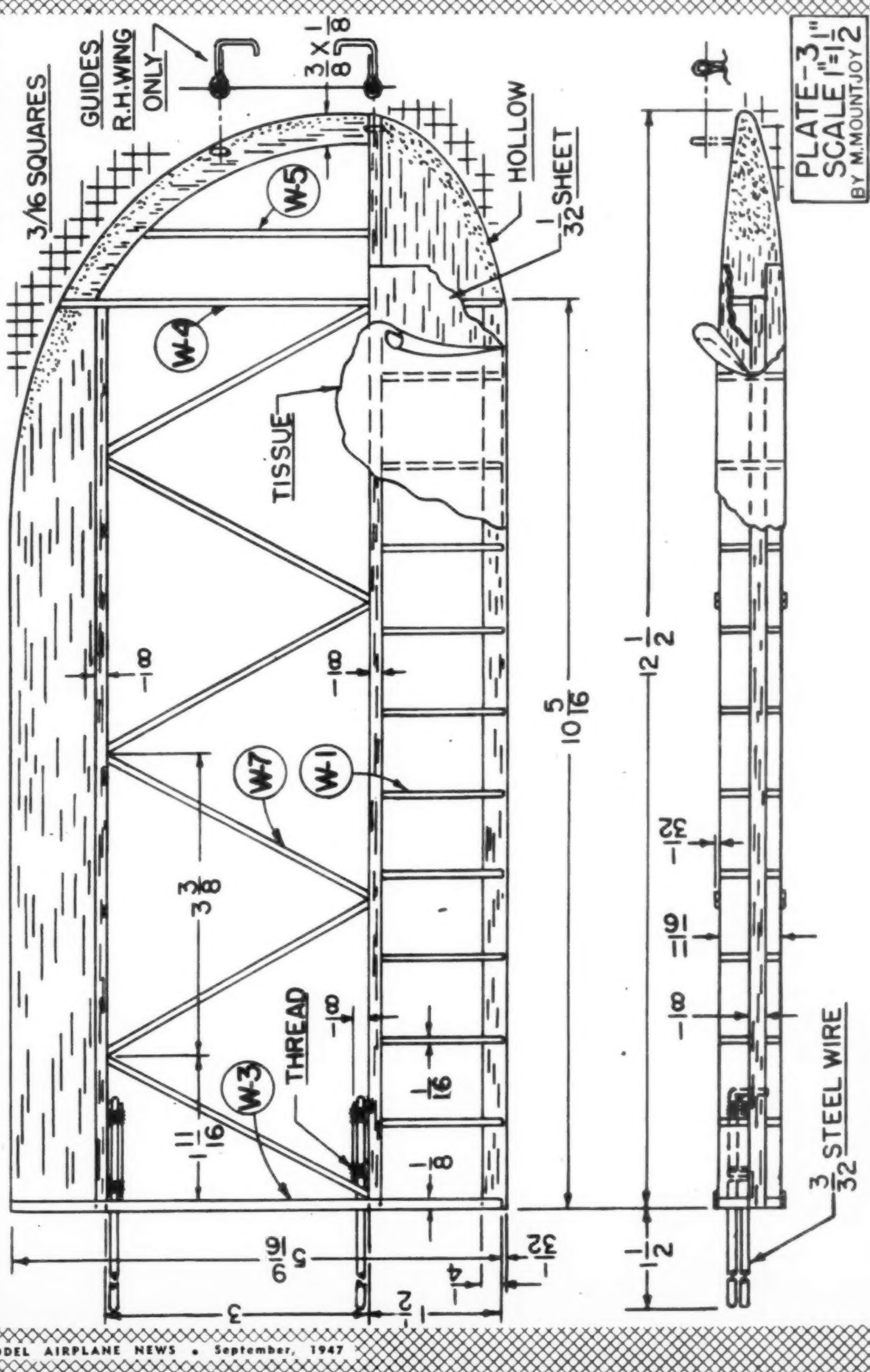
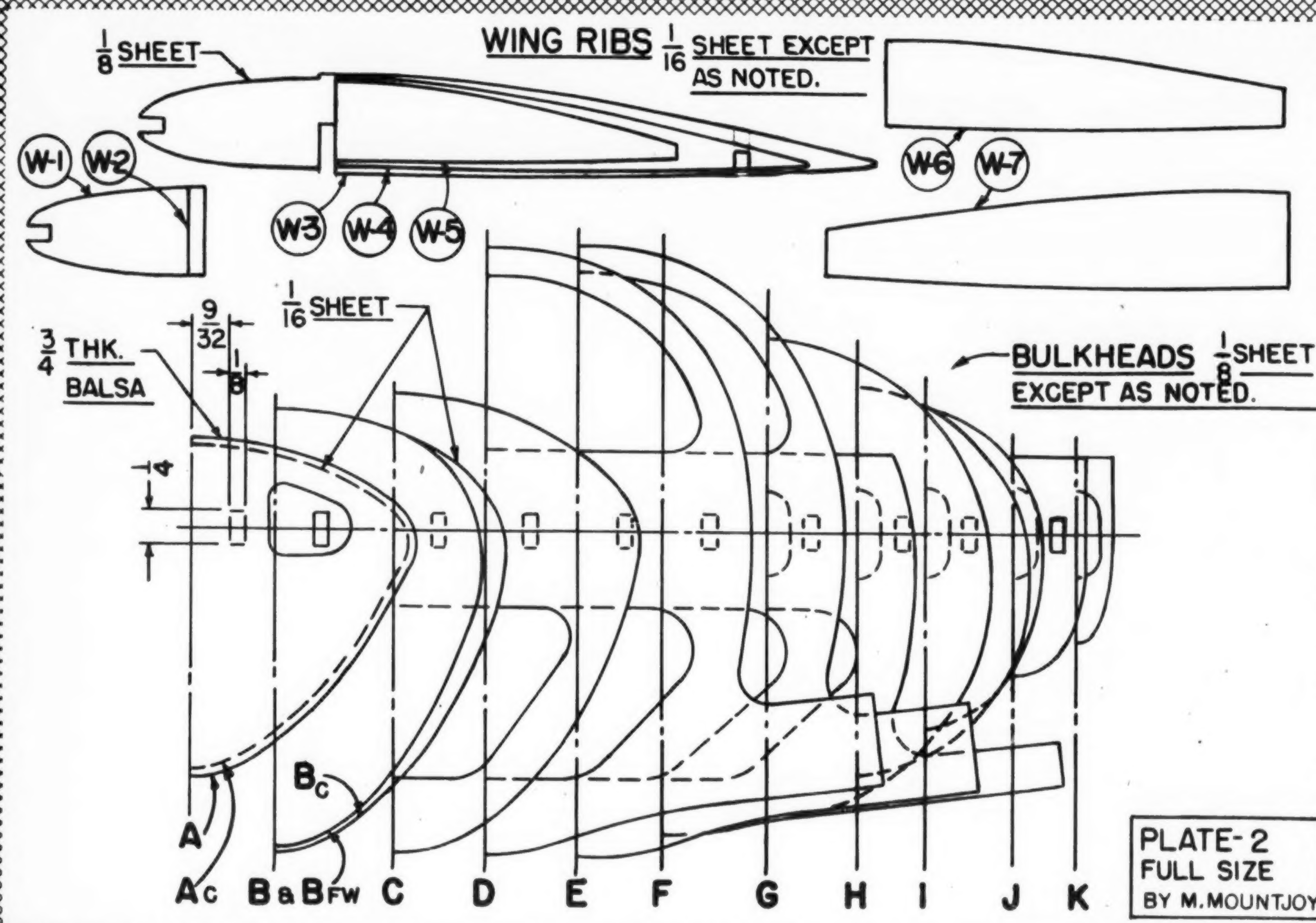


PLATE-3
SCALE 1"=1 1/2"
BY M. MOUNTJOY
3/16 SQUARES
GUIDES R.H. WING ONLY
HOLLOW
1/32 SHEET
TISSUE
THREAD
W-1
W-3
W-4
W-5
W-7
3/32 STEEL WIRE
3/8 X 1/8
10 5/16
12 1/2
3 3/8
1 11/16
5 15/16
1 1/2
3


WING RIBS 1/16 SHEET EXCEPT AS NOTED.
1/8 SHEET
W-1
W-2
W-3
W-4
W-5
W-6
W-7
BULKHEADS 1/8 SHEET EXCEPT AS NOTED.
3/4 THK. BALSA
9/32
1/8
1/16 SHEET
1/4
BC
A
AC
B & BFW
C
D
E
F
G
H
I
J
K
PLATE-2
FULL SIZE
BY M. MOUNTJOY


by CHARLES H. GRANT

**The right prop may mean the difference between success and failure—here's how**

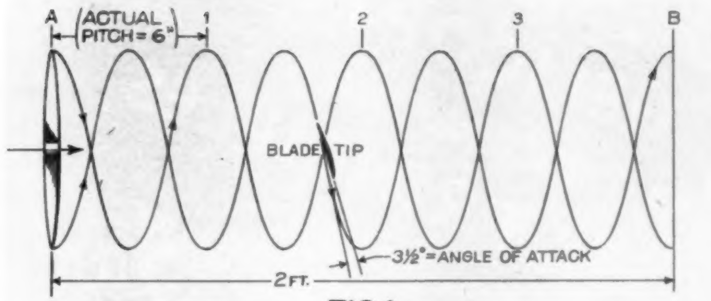



FIG.1

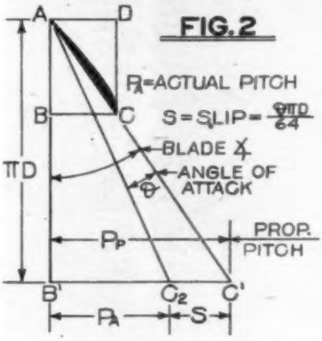



FIG.2

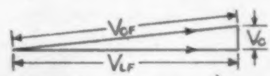



FIG.3

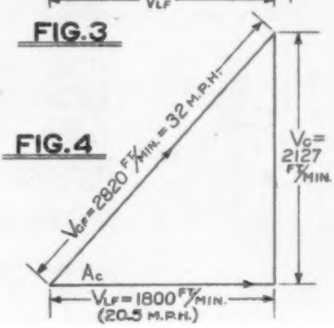



FIG.4

A BROILING midsummer sun beat down on two young model plane enthusiasts feverishly bolting a new propeller to their gas powered model. Something had gone wrong. The prop that flew their former 8 ft. gas model to a record in a Nationals contest had failed them at the most important moment in this, the following Nationals contest at Akron, Ohio. This carefully designed and carved prop had failed to even lift the new model from the ground after its futile run.

There was only time for a guess without a complete analysis of their difficulty. Apparently the 8" pitch of the record breaking prop was too high for this new model with span increased from 8 to 10 ft. The model flew too slowly. So, they reasoned, the prop pitch must be too high and one with lower pitch should be used. Consequently, the young fliers were hurriedly giving the last twist to the prop nut in order to make a second attempt at an official flight. Would this new 7" pitch prop do the job? They were soon on the starting line with the motor "revving" at full speed. The plane was released and the young fliers watched anxiously as it gained speed along the runway and finally lifted gracefully into the air. It worked; the new prop did the job!

This little scene, which actually took place at one of the National model airplane contests, serves well to illustrate the effect of a propeller on the flight of a gas model. This particular model was very heavy and the margin between flight and no flight was small. Consequently any decrease in prop efficiency was clearly evident. On high powered models flown at contests today the reserve power is so great that loss in altitude due to low propeller efficiency is not always clearly indicated. Lack of efficiency is nevertheless robbing the model builder of precious minutes in the air; minutes that win contests when a propeller of proper design is selected.

Some builders concentrate upon designing their planes with the utmost efficiency. They select the highest powered engines that can be used, and then go to the hobby shop and buy "good looking" propellers. In other words, they spend a great deal of time on two vital factors of duration and then guess at the factor which controls the other two. All the links of the chain are strong except one. Obviously the flight will be no better than the propeller. On some planes this particular prop might work beautifully and deliver a large percentage of the power developed by the motors. What is the reason for this?

The effectiveness of any prop is dependent on just one thing provided its basic design is correct; the propeller must have the correct pitch for the revolutions of the engine and the speed of the airplane. A propeller must hook these two together in an efficient manner. How can correct pitch be determined? First, if the prop is to act efficiently the blades must pass through the air at the angle of incidence which gives greatest amount of thrust with least amount of drag on the blade *while the plane is in flight*. A propeller blade is, in effect, an airfoil or wing rotating about an axis, so the most efficient attack angle is the angle of maximum lift drag ratio of the blade section. This, in nearly all cases, is between 3 and 4°; therefore prop blades should be designed so the blades will act at 3-1/2° angle of attack as they screw themselves forward through the air.

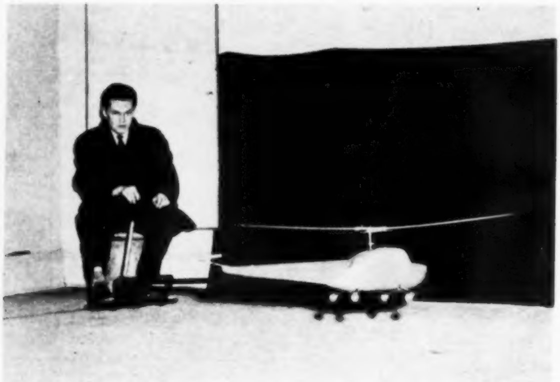
Now the question is—how can we be sure the blades are acting at this particular angle during the flight of the airplane? This is comparatively simple provided two things are known: the number of rpm of the engine during flight, and the flight speed of the airplane. If the plane's flight speed is divided by the number of rpm of the engine, we then know how far the airplane advances in one revolution of the engine. If flight speed is 2000 ft. per minute and the engine turns at 4000 rpm, the plane will advance 6" with know that the actual or effective pitch of every revolution of the propeller. So we the prop must be 6". If the propeller used actually had this amount of pitch it would give little thrust because the blades would be passing through the air at 0° angle of attack when the plane was in motion.

In order to provide proper thrust it must have 3-1/2° angle of attack as explained above, so the blades must have 3-1/2° *more angle* than a prop with pitch equivalent to the speed of the airplane. Fig. 1 illustrates the helical path of the prop tips as they revolve during flight. The distance between points A and B represents the distance covered by the airplane in one minute. As an example, we will assume that the prop revolves 4 times during this minute and while passing through this distance. We will assume the distance is 2 ft. In every revolution the propeller then advances 6". The blade section illustrated on the helical path shows the blade at the correct attack angle of 3-1/2°. It is obvious, therefore, that the theoretical pitch of the prop must be greater than the actual pitch by a certain distance determined by the 3-1/2° slip. This distance is easily calculated for any prop and is equal to $\frac{\theta \pi D}{57}$ where ($\theta$) represents the angle of slip, in this case 3-1/2°. (D) Represents the prop diameter; so inserting the values of 3-1/2° for $\theta$ 10"

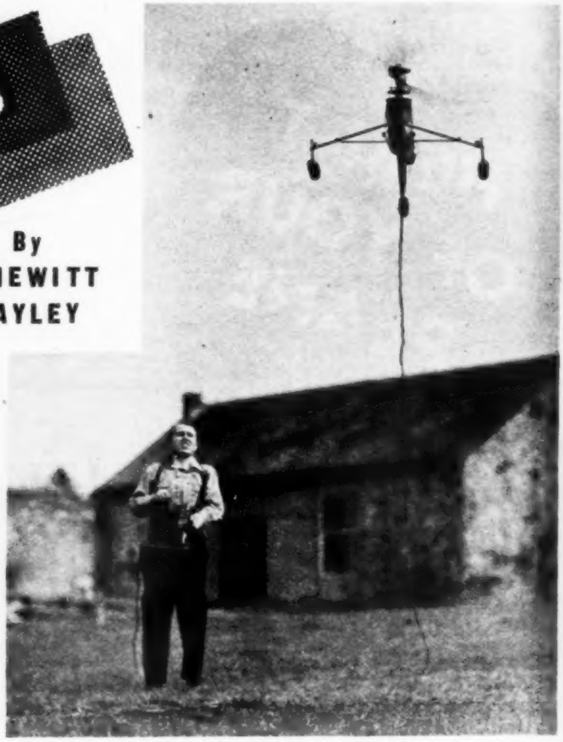
(*Turn to page 75*)

# HELICOPTER PRINCIPLES

By
W. HEWITT BAYLEY



Captive model used to train prospective helicopter pilots



Art Young flies electric-powered model from control box he holds

MODEL builders can do much to push back the boundaries of the unknown in helicopter development. The science is new and there is much to be learned. The helicopter industry needs the support of model builders, but it has done little to provide them with the basic fundamentals with which to start.

The purpose of this article is to acquaint modelers with some of the fundamental problems of direct lift aircraft. We will not attempt to tell how model helicopters should be built, but rather suggest reasons why your attempts to date may not have been up to expectancy. We are going to deal with helicopter general principles and historical developments as they pertain to flying models including rubber, gas, and electric remote control types.

There is no dispute as to the value of model research in the development of rotary wing aircraft. Helicopter history is based on two discoveries, both of which were made by the close observation of model phenomena after large machines had been attempted and abandoned. The first discovery was made by Cierva and was of primary importance. He could not keep blades on his autogyro, which employed a four-bladed rotor rigidly attached to the hub. He built models and discovered that extremely limber blades coned up (increased their dihedral) in rotation. This led him to try flapping hinges at the blade root, thus relieving the stress, and he met with great success.

The second discovery was made by Arthur M. Young at Paoli, Pa., in 1939. He discovered the properties of a universally mounted rotor providing the helicopter with a high degree of inherent stability. Most helicopter research up to that time had been based on autogyro theory and experience. Young's discovery was made on a true helicopter.

Young, who has made perhaps the most significant contribution to the science of helicopter flight, namely, dynamic stability, began experimenting in 1928. In 1941 Bell Aircraft Corp. offered him its facilities for construction of a full scale helicopter. 13 years of research with models was the basis for the highly successful Bell Model 47B helicopter, now flying commercially throughout the U.S., Alaska, and Sweden. This article is accompanied by photos of some of the many models employed during the development of the Bell machine.

Arthur Young's experience with models in the early days will provide model builders with a starting point and will furnish them with information that will eliminate many hours of painstaking and perhaps futile work.

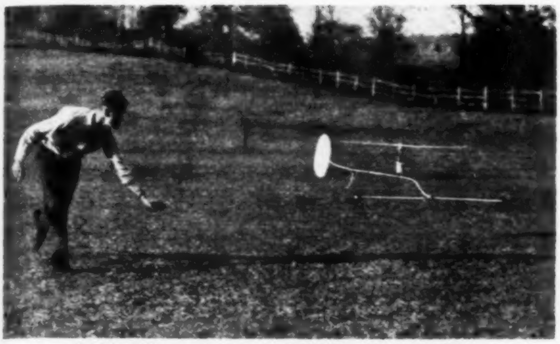
The first problem to be faced with helicopters is stability. All helicopters are basically unstable. Many of those built were constructed to have sufficient lift, but were kept in the air only by the constant and skillful efforts of the pilot.

The early attempts at helicopter flight were characterized by wild gyrations, with ground crew frantically clinging to the windmill gone crazy. Usually these gyrations were a swinging motion of the aircraft, in most cases ending in a crash. Oehmichem tried to overcome this tendency by suspending his helicopter from a balloon. Pescara's ship was overturned by the downwash of an airplane flying some distance above it. Breguet's helicopter was smashed on landing from a flight of but a few feet; and Bleeker's machine was damaged in an indoor hovering test. Even with diligent efforts on the part of the pilot in both horizontal and hovering flight, early helicopters tended to tip one way then the other with increasing violence. This severe instability was a deterrent to further development and caused many projects to be abandoned.

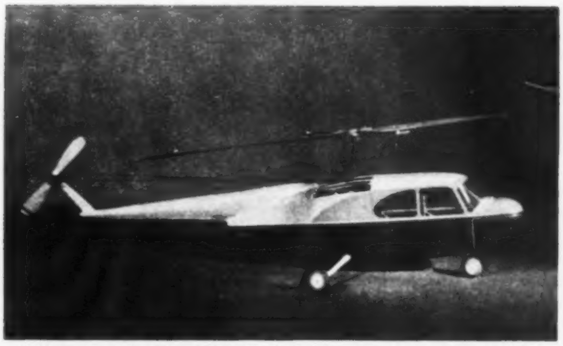
The early flights of Igor Sikorsky are remarkable in this respect: by responsive controls obtained in separate control rotors, and by increasing the lateral and longitudinal inertia of his machine through booms supporting the control rotors, he obtained a helicopter which, while inherently unstable, could be flown by diligent use of the controls.

What stability it was possible to achieve in early helicopters to keep the ships right side up, was principally due to pilot skill. This is largely true today with ships employing the fully articulated rotor; that is, rotors with flapping hinges and drag hinges, which we will discuss later. It is obvious to model builders that they will not have the benefit of a pilot in the model to keep it right side up, nor will the wondrous results obtained from "g" line control help them much. Therefore, in order to get into the air and back again to earth safely, the first problem to tackle is stability. How can we construct a model helicopter with the required inherent stability?

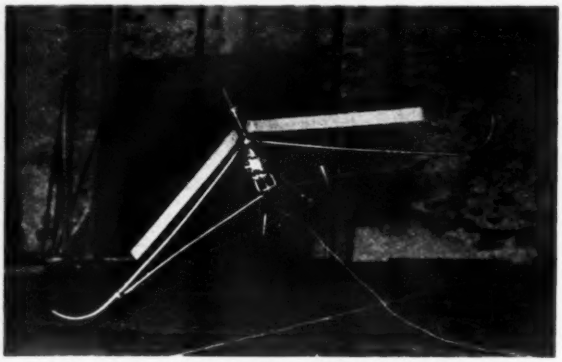
Let us review the work which led to the stable helicopter; in so doing it will be necessary to follow the development of Arthur Young's models as illustrated herewith. For a helicopter to be neutrally stable—that is, like a ball—it is necessary for the center of gravity of the entire machine to coincide with the center of lift, which is the rotor center. This calls for a well nigh impossible structure, for it would be necessary to have the rotor in the middle of the machine with the pilot above and the engine beneath the rotor, or some such arrangement. An alternate solution would be to have two rotors, one above and one below the fuselage, a form shown recently in one of Pescara's patents. This configuration presents difficulties for landings and takeoffs, even for rubber powered stick models. Though many models of this type have been flown successfully



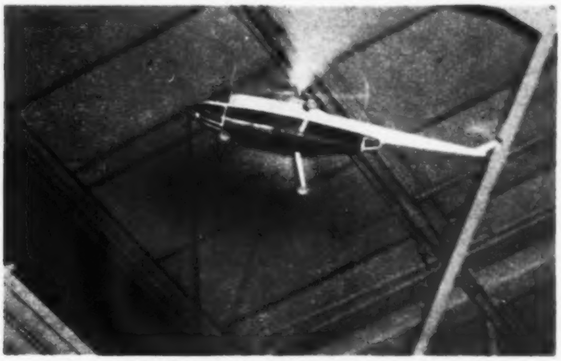
Electric G-line model was used during early test flights



Rubber powered scale model with belt driven torque prop is good flier



Unstable early model starts violent oscillation. Rigid rotor was used



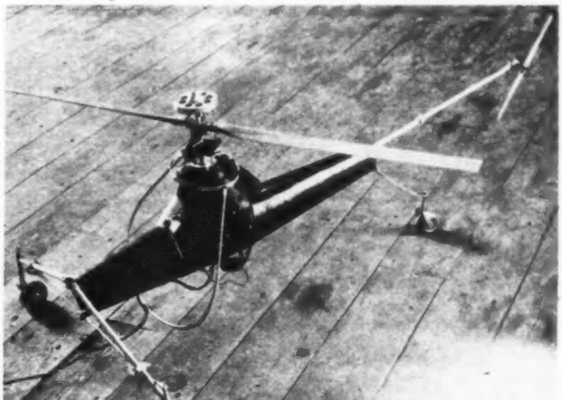
Rubber model helicopter after R.O.G. flies among the rafters

(Shoenky's '46 Nationals winner was basically of this type); they do not approach the problems of full scale flight. It is necessary to have stability which will permit the rotor to be mounted above the fuselage and still provide stability.

The stable rotor is the chief concern of model helicopter builders. Once a stable model has been developed by the modeler, then it is possible to achieve free flight, remote control, or radio control. To attempt to fly an unstable model helicopter by any means is a feat requiring great luck; it is the cause of many dismal crackups. A comparison of hinged and rigid rotors free suspended in a wind tunnel showed in early experiments that the hinged rotor was to be preferred. A rigid rotor is one which allows no flexibility between the mast and the rotor blades. A hinged rotor permits the individual blades to flap up and down with respect to the mast.

Cierva made a great contribution to helicopter development with his autogyro work when he developed the three-bladed flapping hinged rotor which allows the advancing blade to rise and decrease its lift. Following this development his ship could remain right side up in forward flight because life on both sides of the rotor disc (area swept by rotor blades) was equalized. However, the rotating wings of the second Cierva attempt had a disturbing tendency to break off at the hub. The cause for this was found to be the tendency for the advancing blade to take a new lateral position with respect to the hub, as it flapped up. The stress set up once each revolution, due to this geometric asymmetry, soon caused blade failure at the hub or hinge.

Cierva introduced the drag hinge which gave each blade two degrees (or directions) of freedom, allowing them to flap up and down, also forward and back in the plane of rotation. Thus, as the blades coned up they lagged behind their original position and relieved the stress at the hub. This rotor configuration is known today as the fully articulated rotor. The arrangement was satisfactory for autogyros which required no pitch changes, either collective or cyclic. However, when power was fed into the rotor for lift, pitch changes were required, and the mechanism became unduly complicated. Hubs with thrust bearings capable of carrying the centrifugal loads and controls were early stumbling blocks because of the required adequate and positive damping in the drag hinges to overcome vibrations. This configuration presents difficulties to the builders of model helicopters but a simple adaption can be used for autogyros. In fact, there is a very good "g" line gyro kit on the market now that provides excellent flying qualties, but it is doubtful from the stability standpoint if this ship could be flown without benefit of "g" line.

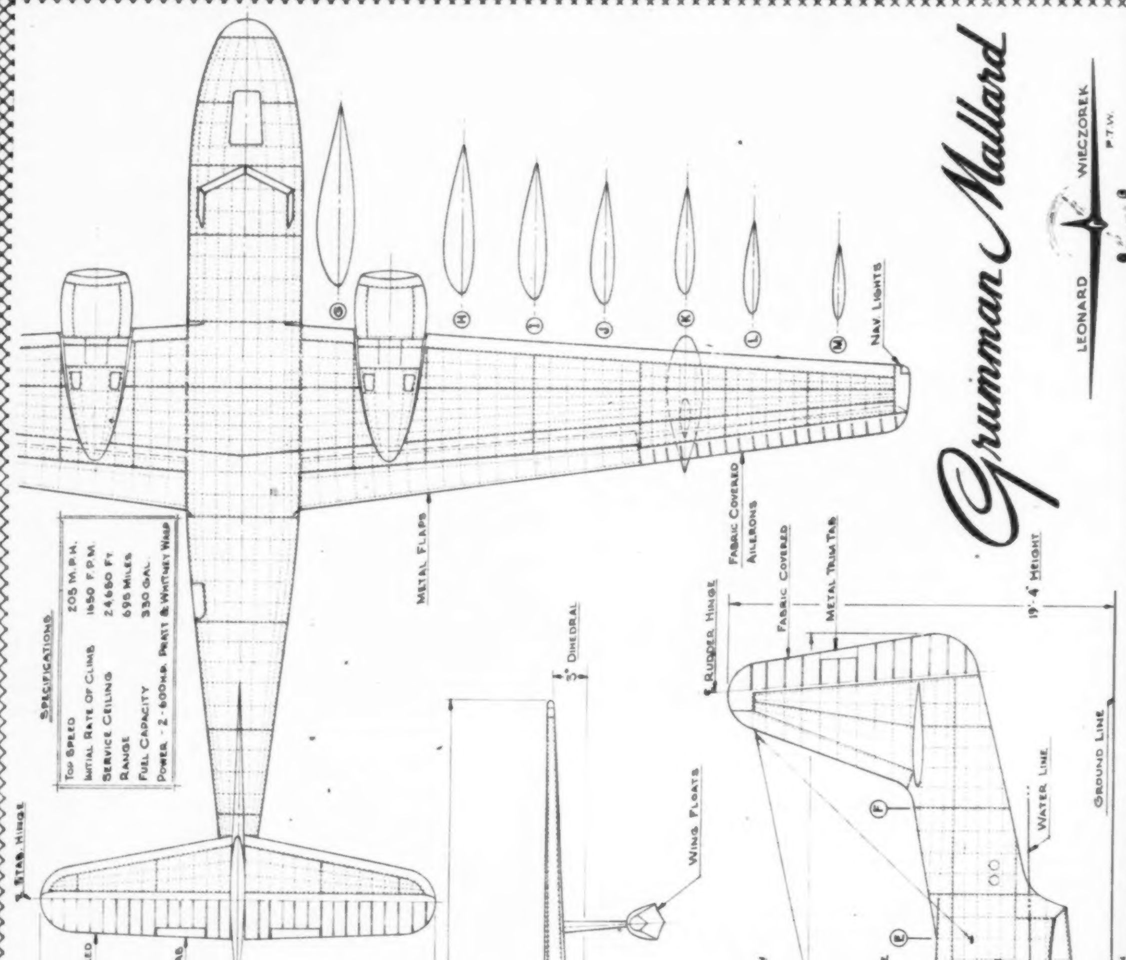


Closeup of electric model with flywheel used instead of stabilizing bar

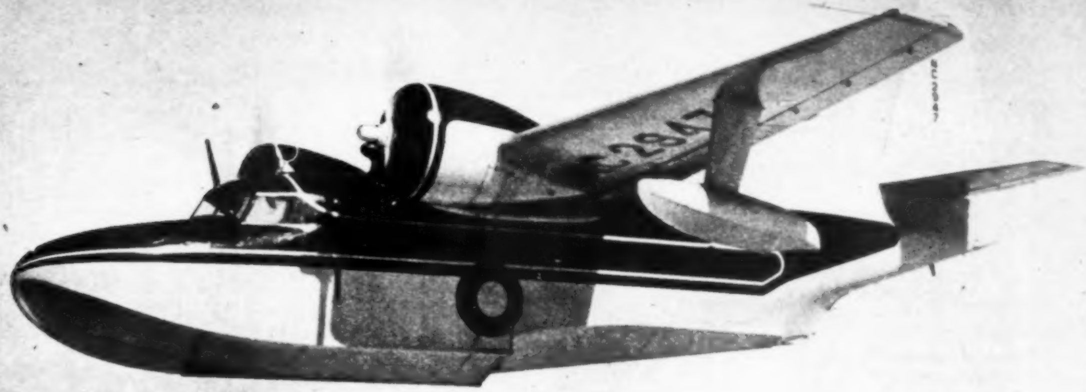
In a homemade wind tunnel, Young's experiments with the hinged rotor showed that while hovering the model could be made to take any angle with the wind, varying the amount and direction of feathering by tilting the machine, and the model appeared to have stability for any one set of given conditions. However, when free flights were attempted it was found to be impossible to obtain flights of more than two seconds with the hinged rotor, due to pronounced instability. This instability was characteristic of the full scale machines; that is, rolling over or tipping of the model soon after takeoff, followed by its moving rapidly in the direction of tip. It would then tip back as speed increased, slow down and move rapidly in the opposite direction. The amplitude would increase until the model upset and crashed, putting research back several days while repairs were made.

Young made rotor blades in lots of one dozen (over 500 in all). Studying this matter closely, the key to stability was

(*Turn to page 42*)



Grumman Mallard
Leonard Wieczorek
P.T.W.
Specifications
Top Speed 205 M.P.H.
Initial Rate of Climb 1850 F.P.M.
Service Ceiling 24680 Ft
Range 695 Miles
Fuel Capacity 330 Gal.
Power - 2 - 600 H.P. Pratt & Whitney Wasp
Fuselage Sections
A
B
C
D
E
F
W.L.
G
H
I
J
K
L
M
Nav. Lights
Metal Flaps
Fabric Covered Ailerons
Stab. Hinge
Fabric Covered Elevators
Metal Trim Tab
19'-9"
Propeller Arc
Span 66'-8"
3° Dihedral
Wing Floats
Main Landing Gear - Side View
Overall Length
48'-4"
600 H.P. Pratt & Whitney Wasp
Passenger Entrance Left Side Only
Rudder Hinge
Fabric Covered
Metal Trim Tab
19'-4" Height
Water Line
Ground Line
Wheel in Retracted Position
Nose Wheel Well



# GRUMMAN MALLARD

## PLANE ON THE COVER

LEROY GRUMMAN is one of a very small handful of aircraft manufacturers in the United States today whose future seems reasonably assured. Others in that handful are optimistic because of (1) adequate financing, (2) low cost production operations, (3) progressive engineering, or (4) luck! Grumman has all these in useful, if not large, quantities—but above all he has one outstanding asset in his business: realistic planning.

Included in the current activities of Grumman Aircraft Engineering Corp. are experimental jet fighters, torpedo-bombers, and research on pilotless aircraft and supersonic guided missiles. As promising as many of the projects appear, Grumman views these radical ventures against his tried and proven yardstick—"They'll need plenty of development work!"

For it has been by the development of good, basic designs through many progressions (most notable of which was the biplane fighter series, FF, F2F and F3F) that Grumman established his reputation. It is a little known but salient fact that he has followed and is following the same pattern in his amphibian designs which exemplifies his private, technical and business personality. Four steps in the progression of the Grumman cabin amphibian have been revealed and it is one of these, the Grumman *Mallard*, that is our Plane on the Cover this month.

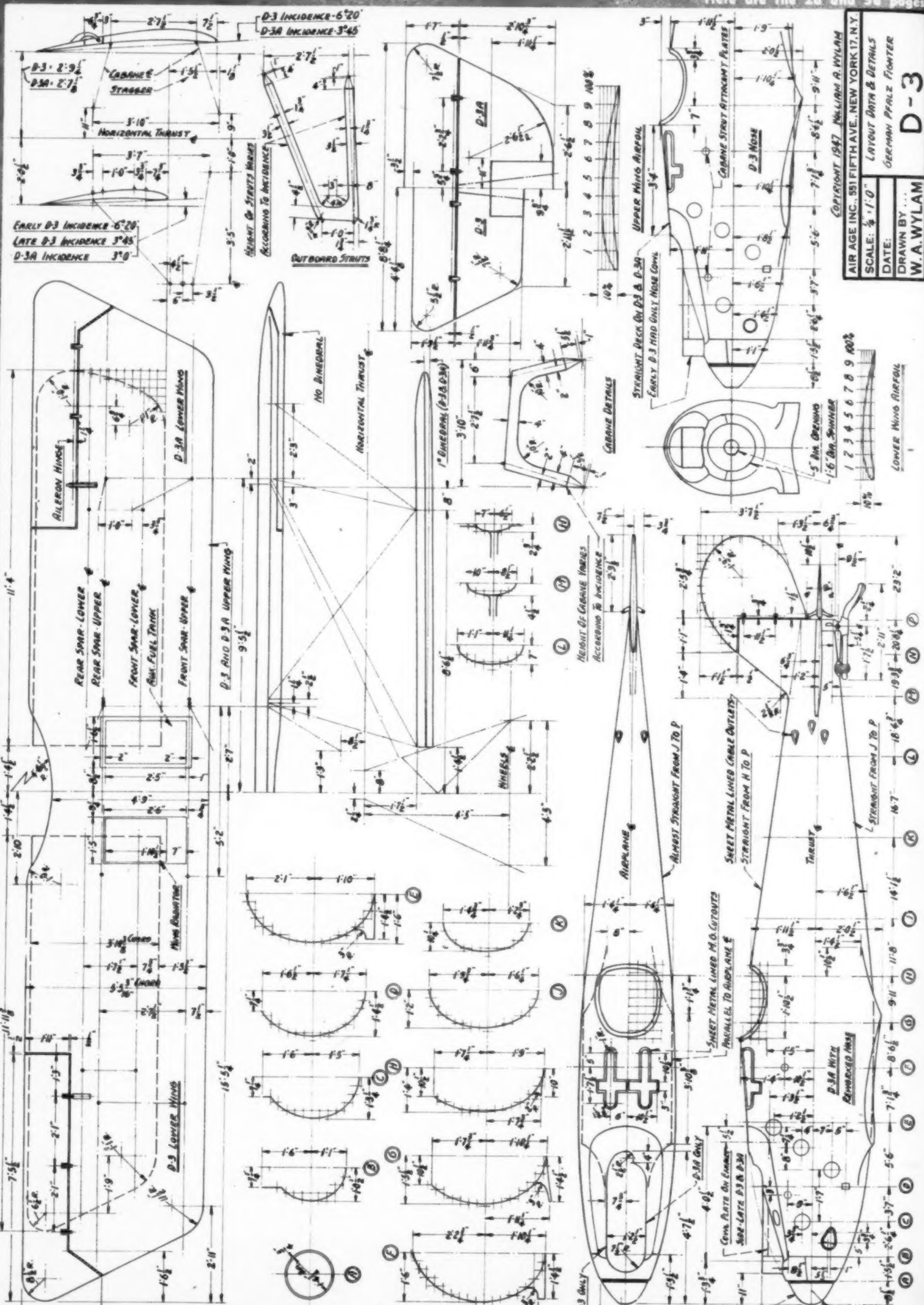
First step in the plan was the Grumman G-21, a four ton twin-engine monoplane introduced in 1937. Immediately after test flights it was snapped up by the Navy, and it continued in quantity production right through V-J Day. Eight years of continuous production is a record matched by few others. In all, about 250 were built, seeing service in the U.S. Navy, U.S. Coast Guard, Royal Canadian Air Force, Royal Air Force and an extensive list of U.S. and foreign owners. The 8-passenger *Goose* was powered by 800 horses and cruised at better than 170 mph, certainly an admirable performance for a flyingboat hull with amphibian gear attached.

Next step was a half-size version of about two ton weight carrying 4 or 5 passengers and powered by economical 200 hp engines. But the *Widgeon*, too, was caught up in the Navy's expansion and went to war as the J4F. Navy production got underway at Pearl Harbor and continued to the spring of 1945, a total of 150 wearing Navy colors during the war.

Third step in the process is the six ton *Mallard*, design-wise an extension of the 2-4-6-ton scale but in detail an entirely new airplane in the stable of American executive transports. Last step (so far announced)

(*Turn to page 38*)

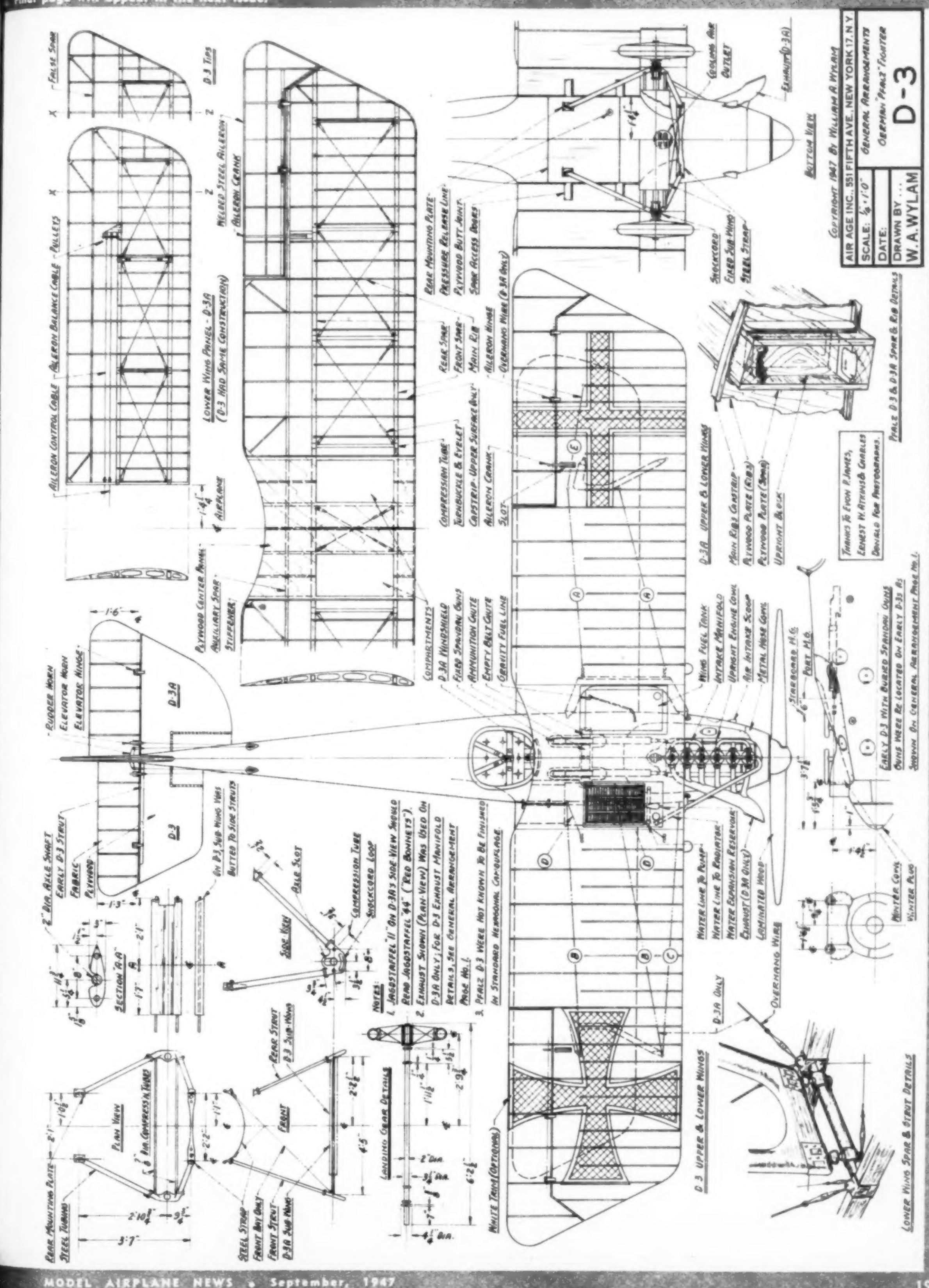
Here are the 2d and 3d pages of





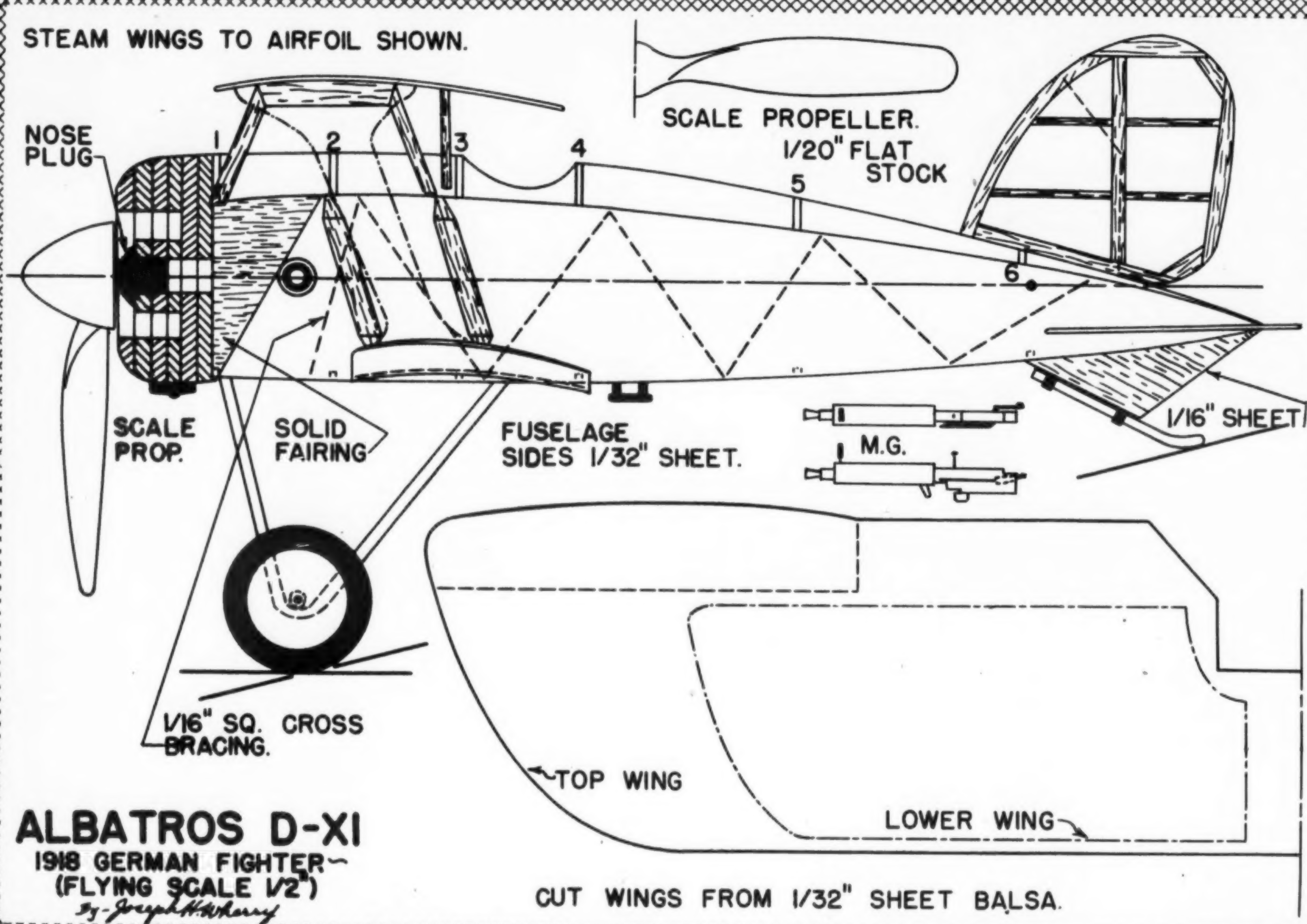

● WYLAM MASTERPLAN ● WYLAM MASTERPLAN

Final page will appear in the next issue.

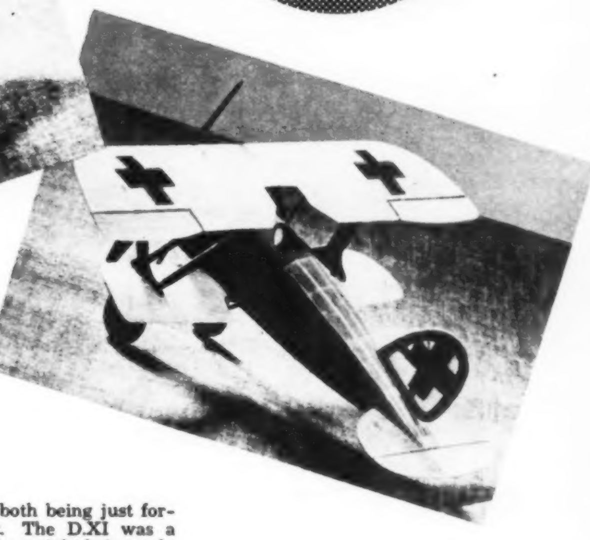





WYLAM MASTERPLAN ● WYLAM MASTERPLAN


STEAM WINGS TO AIRFOIL SHOWN.
SCALE PROPELLER.
1/20" FLAT STOCK
NOSE PLUG
1
2
3
4
5
6
SCALE PROP.
SOLID FAIRING
FUSELAGE SIDES 1/32" SHEET.
M.G.
1/16" SHEET
1/16" SQ. CROSS BRACING.
TOP WING
LOWER WING
ALBATROS D-XI
1918 GERMAN FIGHTER
(FLYING SCALE 1/2")
CUT WINGS FROM 1/32" SHEET BALSA.

# ALBATROS D-XI



**by JOSEPH H. WHERRY**

MODELS of First World War planes have always ranked high in popularity with scale builders. Most every serious model builder has built several. This author prefers planes of the 1914-19 period because, if carefully built, one can be assured of excellent flights. Generally these oldtimers are easy to model, detail can be added to the heart's content, and they can be easily adjusted to give good performance.

Albatros fighters have been among the most popular of the First War's aircraft, particularly the D.III and D.V types. If you have followed the designs of this writer in past issues of M.A.N. you will recall that models of unique and little known types are his meat. Therefore, another unusual model is presented herewith.

The Albatros D.XI was a late war development of the Albatros Flugzuegwerke which had its main facilities at world famed Johannisthal Airdrome near Berlin. Much smaller than the D.III and D.V types, its wingspan was just 8 meters, or approximately 26 ft., 3 in. Contrary to the usual Albatros practice, the fuselage was slabsided; however, the peculiar horizontal tailplane was retained. The forward position of the vertical tailplane is a point to note. The most radical departure from previous Albatros practice was in the powerplant which was an air-cooled Siemans-Halske rotary engine of 160 hp. This engine was beautifully cowled, and the streamlining of the entire ship was accented by the lack of flying or landing wires and by the interplane struts which were of the single I Strut type. Two smaller struts ran between the bottom wing and top longeron of the fuselage.

Armament was two of the inevitable Spandau machine guns, one centered on the cowl, the other mounted on the right side of the fuselage, both being just forward of the cockpit. The D.XI was a light weight fighter, the weight being only 1050 lbs. The duration was 1-1/2 hrs., maximum speed at least 119 mph, and the climb was excellent—over 16,300 ft. in 18 mins. All in all it was a great ship and ahead of its time. The modern Vultee V-11-G.B. attack plane and others have used the forward mounted rudder to advantage. The visibility was superior to most 1918 jobs, and there is a certain amount of dash to the whole ship.

The plans are accurately scaled from the best available data to ½ inch to the foot. Construction is simplified, even over that of the author's Westland N-17 fighter-bomber (Oct. '46 M.A.N.). The fact that only the tail surfaces and the top and bottom of the fuselage need be tissue covered greatly simplifies construction. Since the wings of the real plane had very thin sections, 1/32" sheet balsa was used for them as it was for the fuselage sides. The finished weight is little, if any, heavier than for a model of conventional construction. Only a few evenings are needed from start to finished plane, and the flights are excellent for a model of this small size. So—let's get to work with the balsa, etc.

FUSELAGE—Cut two fuselage sides to shape from 1/32" sheet balsa; sand thoroughly on both sides with fine sandpaper. The sides should now be approximately 1/40" in thickness. Spread a good grade of wood filler on both faces of the side pieces. The material may be spread on, then rubbed into both faces at once with thumb and forefinger on either side. Spreading the filler on both sides in this manner prevents warping. The dash lines on the side view indicate a crossbracing of 1/16" square balsa. These strips are cemented in place at this time. The only formers needed are for the fuselage top, so cut one each to shape from 1/16" sheet. Cut the stringer notches to take 1/32" by 3/32" stringers. Join the two sides together at the top with the formers and at the bottom with 1/16" square pieces as indicated by the small dash squares along the fuselage bottom on the side view. The extreme rear of the fuselage is not joined at this time, but the notch that carries the elevators may be cut for use later.

Cement the 1/32" by 3/32" stringers in place; cut the rear ends of the stringers off even with the end of the fuselage.

The cowl is built-up with layers of ⅛" sheet balsa. Use the front view to achieve the correct overall cowl outline. The side view can be checked for the inside cuts for the various cowl layers. The grain of the layers can be varied to result in a real job of lamination. The front four layers of the cowl are cut out at the bottom (see front view) to allow for placing the three lower dummy cylinders which are cut from bits of scrap balsa. Short circular pieces are used for the remaining cylinders.

Cement the cowl in place and sand so as to streamline into the general contours of the fuselage. Solid pieces of soft balsa cut to shape (see side view) are cemented in place on each side of the fuselage and against the rear of the cowl. These are

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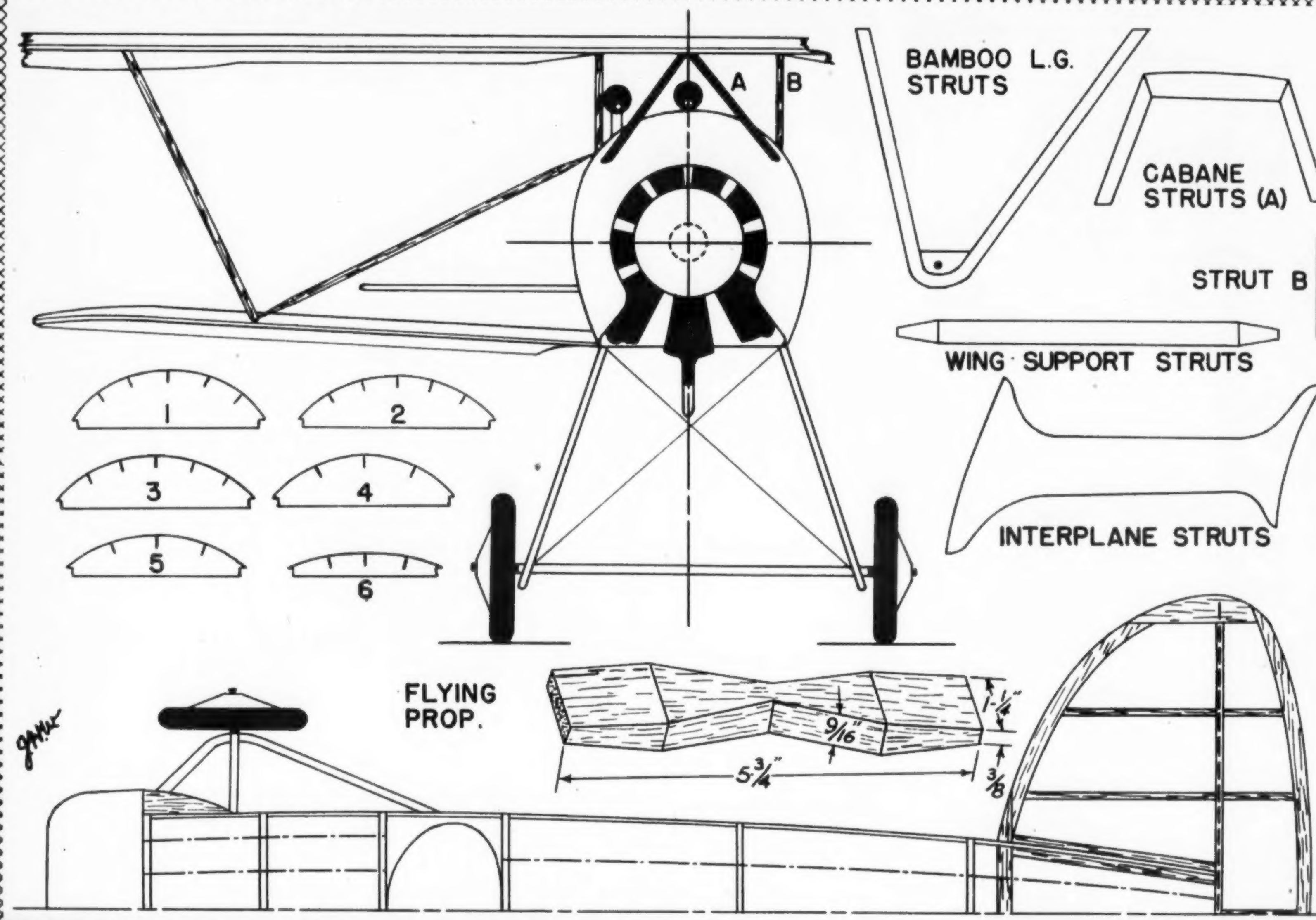
A
B
BAMBOO L.G. STRUTS
CABANE STRUTS (A)
STRUT B
WING SUPPORT STRUTS
INTERPLANE STRUTS
1
2
3
4
5
6
FLYING PROP.
1-1/4"
9/16"
5 3/4"
3/8

# COCKPIT RADIO CONTROL

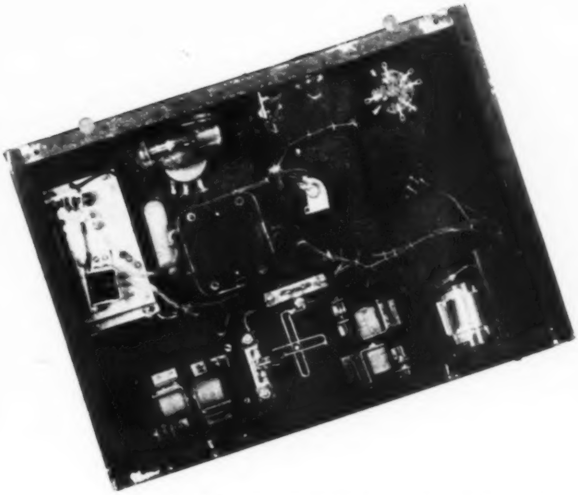

Fig. 11 Under view of modified ground control console

## PART TWO

### by JAMES R. CUSTIN

THIS ground control unit proved to be fairly dependable in operation once the "bugs" were eliminated. It was rather interesting to try to fool it by moving two of the controls simultaneously. It wouldn't be fooled. The selector rotor would simply step around until it came to the first contact corresponding to one of the controls selected, run the monitor brush to center on that control, then continue on its way to center the other control—all with complete mechanical nonchalance.

Once the airborne selector had been manually positioned to correspond to the ground selector, it would of course follow it perfectly—in theory.

Unfortunately there were some discrepancies between theory and practice in this respect. One of these discrepancies resulted in a pair of torn pants and a messed-up airplane when the model made a right turn instead of the left requested by the pilot and sailed proudly into a tall tree. Tom, more concerned about the life of the B battery than his dignity, shinnied up the tree trunk with considerable haste. In due time he reached the model and turned off the receiver switch, but he looked a little odd coming home with his trousers patched in critical spots with model airplane tissue!

We later found that the airborne unit had missed a beat because of a sheared wire in the receiver. Engine vibration had proved too much for the single strand hookup wire we used, and it broke in such a way that the loose ends made contact most of the time but occasionally parted. The moral, of course, is to use multi-strand hookup wire.

Lost beats also occasionally resulted from a directional transmitter antenna—a problem that can be overcome with a little more engineering.

After a time we added an "extra pulse" switch in parallel with the contacts of the transmitter keying relay. With this the operator can key the transmitter manually so as to step the airborne selector around to a position corresponding to that of the ground selector. While primarily intended for use in preliminary manual synchronization of the selectors, its emergency value in the event of a lost carrier pulse is obvious.

Interference signals are another possible cause of desynchronization of selectors. The probability of interference can be reduced by allowing the transmitter to remain on the air and keying it off to provide the pulses. This method of operation almost completely eliminates the interference problem and has the added advantage of reducing the receiver B battery drain since, with the carrier on, the receiver B drain is only .2 ma. The disadvantage of this method is that the transmitter takes more average power from its battery.

The selector itself was one of our biggest sources of trouble, however.

Fig. 2 (see Part I in the August 1947 issue) is a top view of the airborne selector that we built for our first model; Fig. 3 is a bottom view of the same device. It will be noted from Fig. 2 that this selector has ten stationary contact segments. This was not entirely a matter of choice. In casting about for suitable ready-made ratchet wheels we came across a pair of gear shaped routers of the type used in drill presses. While these filled the bill perfectly, they had ten teeth; consequently we had to provide ten contact positions, some of which were destined to remain as "empties" although they would all be available, if desired, for gadgets such as a parachute or bomb release mechanism.

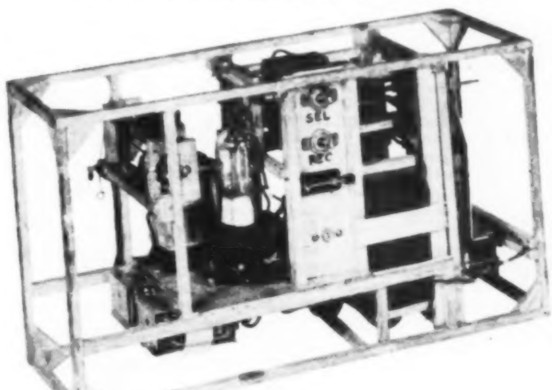


Fig. 9 The entire airborne control system is in a single unit

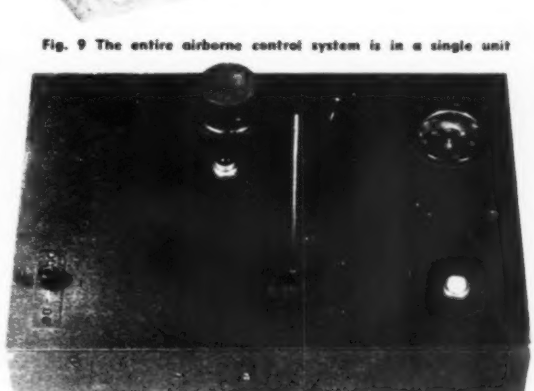

Fig. 10 Top of ground control. The "stick" projects upward

The pawl and ratchet mechanism was the source of most of the selector troubles. A helical phosphor-bronze brush spring secured to the top of the router spindle (see Fig. 2) serves as a rotary contactor. The entire ratchet and spring assembly is relatively light, and the brush spring creates a small amount of frictional drag. Nevertheless, the snap action of the armature upon energization of the selector magnet tends to throw the rotor a little more than one step at a time as a result of inertia of the rotor assembly.

The problem was eventually solved by means of the stop arrangement illustrated in Fig. 8 (see page 24). This was not too satisfactory, however, since the small diameter of our "ersatz" ratchet wheels (about ⅝") necessitated extremely close stop adjustments. A rubberband escapement was used to

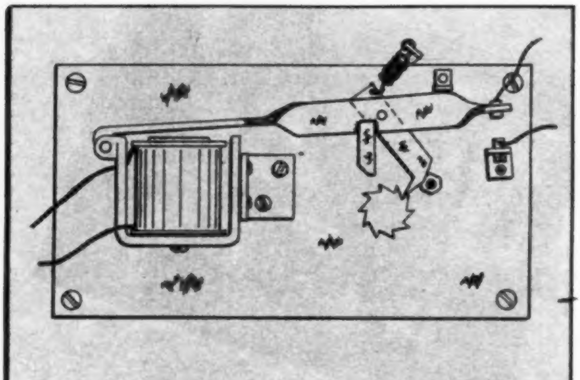

FIG. 8 - PAWL STOP MECHANISM

(Above) Tiny ratchet wheel requires close adjustment

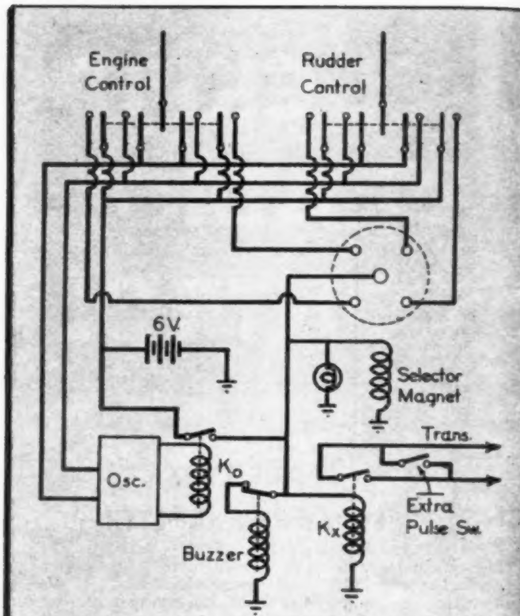


FIG. 12 - MODIFIED CONSOLE CIRCUIT

(Right) Simplified control circuit omits many parts

actuate the airborne selector in a later model. The pawl and ratchet selector originally installed in the console was, for some reason, less temperamental than that in the airborne unit and we continued to use it in a later ground control station.

The selector contact disc shown in Fig. 2 is a homemade bakelite casting having copper contact segments imbedded in it flush with its upper surface. The segments were cut from a disc turned from sheet copper, and were then lightly cemented to a thin sheet metal disc. This assembly was placed, segments upward, at the bottom of the die portion of a mold improvised from cast iron pipe fittings, and the die and plunger were heated in the kitchen oven at 375° F.

After 15 or 20 minutes, when the mold had been brought to the temperature of the oven, it was removed and the required amount of bakelite molding powder immediately poured into the die, onto the segment assembly, and the plunger was inserted on top of it. The die and plunger were then placed between the jaws of a small bench vise which was screwed up as tightly as possible to apply pressure to the bakelite. The mold parts had to be wrapped in towels, of course, so they could be handled without causing blistered hands.

When the casting was removed from the mold we pried the light sheet metal off the contact segments and scraped the cement off the segment surfaces. Connecting wires were soldered directly to the outer edges of the contact segments. Since bakelite tends to warp or swell under the heat of a soldering iron, we covered the contact disc with a wet rag during the soldering operation, leaving only a small area at the edge of the segment exposed for soldering. As soon as the solder connection was made, a squeeze of the rag wetted and cooled the entire disc.

The servos and servo monitors presented no particular problems. We used small permanent magnet Pittman motors and found them quite satisfactory. These are three pole motors, weighing about 1⅝ ounces each and operating on 6 volts. A 10 tooth pinion on the motor shaft meshes with a 48 tooth gear on the lead screw. The lead screw is a piece of brass or drill rod stock having a 6-32 thread along 2½ in. of its length.

Although there is nothing in the system which constrains the lead screw of the monitor unit to turn at the same speed as its airborne counterpart, we found in practice that the two actually stay very well synchronized. Any discrepancies may be compensated for by means of a variable resistor in the monitor motor circuit.

The entire airborne unit, including batteries, is built into a single framework (see Fig. 9) so that it may be removed from the model as a unit for repairs and service work.

Our ground console was constructed on a large receiver chassis (see Fig. 10). A pilot light in parallel with the keying relay gives the operator visual indication of what the console unit is doing. The B battery for the relaxation oscillator is mounted in the console chassis and plug-in sockets enable rapid connection of the console to the transmitter by means of a long hookup cable. The "stick" is a piece of drill rod, about ⅛ in. in diameter, which threads into a small socket at its lower end so it can be removed during transportation of the console.

All relays used in the console were homemade since no suitable 6 volt relays were on the market at the time of our experiments. It is possible, however, that relays which will meet the requirements of the monitor system are now available, and anyone intending to build a radio control unit of this kind would do well to investigate War Surplus listings of aircraft relays.

Although the console diagram, Fig. 6, indicates use of triple pole relays for $K_1$ and $K_2$, we actually used only single pole relays, connecting them in parallel to provide the necessary number of poles. When the console was in operation the numerous fluttering relay armatures looked like a field of grain waving in the wind, so we nicknamed the console "the wheatfield."

The console pictured in Fig. 10 is actually a later model than that diagramed in Fig. 6. Fig. 11 is a bottom view of this later console.

In an effort to avoid some of the problems which had bedeviled us in our first experimental unit, we compromised with our desires and developed a modified system somewhat along the lines of that which the Army uses in its small target models, employing our automatic selectors, however, rather than the multi-channel system used by the Army.

Fig. 12 is a diagram of the ground console for this system. It will be seen that there are no monitors in this console, and it is scarcely a "wheatfield" since the number of relays has been cut to two.

In using this modified control unit, the operator moves his controls in the same directions as with the original "wheatfield," but in doing so he merely closes one of the two double-pole switches linked with each control. One pole of this switch closes the relaxation oscillator circuit and thus starts the selector stepping, just as in the "wheatfield." When the selector arrives at the segment corresponding to the selected control position, it closes a holding circuit through the other pole of the switch, and the selector remains on this segment until the switch is released.

Monitoring is effected by means of a high frequency buzzer in parallel with the transmitter keying relay. Thus the operator hears a series of short "beeps" from the buzzer, designating each of the selection pulses, followed by a long "beep" for the control pulse. The long "beep" continues as long as he holds the switch closed. He must therefore estimate control position by the length of the long "beep" and by observing the response of the model.

A pilot light wired in parallel with the transmitter keying relay provides a visual check on the buzzer.

The airborne unit used with this console is exactly the same as that used with the "wheatfield," and it works in the same way.

Since, like the "wheatfield," the modified console requires sequence selectors, its biggst advantage over the "wheatfield" is its simplicity. A secondary advantage lies in the fewer relays it requires. Experimenters interested in developing a cockpit type control system may do well to reverse the procedure we followed and begin their experiments with a circuit like

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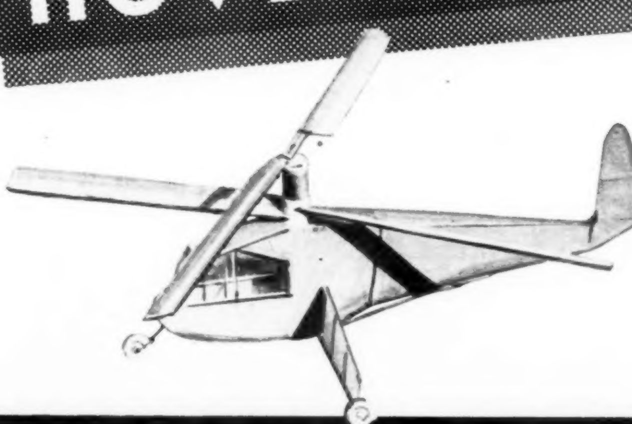
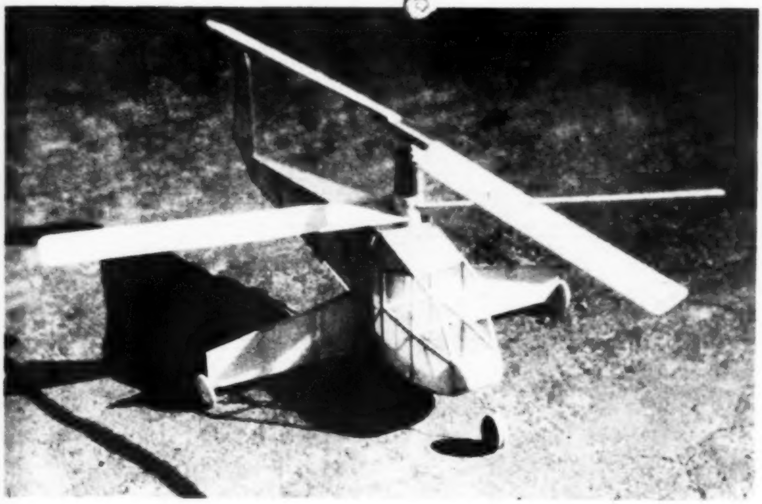
# HOVERBUG





**by ROY L. CLOUGH, JR.**

## This stable model gives true helicopter performance

DESIGNED to fly vertically, forward or back, this rubber powered helicopter is easy to build and certain to give good results.

Instead of individual rotor blade articulation which is usually necessary to secure steady flight, the entire rotor mechanism of this machine is permitted relatively free motion about its point of attachment. This motion must be limited in order to obtain forward flight; therefore there is only 1/8" clearance between the rotor tube and the fore and aft cross-members. Side motion is permitted up to the width of the fuselage, about 1/2" in each direction.

A long fuselage is used on this model to spread its mass over a large area, thus minimizing disturbing effects which may occur in the rotor. A high tail fin performs the function of maintaining proper heading and brings the CLA into a favorable position relative to CG.

Despite appearances, the vertical control surface employed on this model does not create an untoward amount of drag in forward flight. This is because the actual relative wind is largely downward in the immediate vicinity of the ship. As shown in the photographs this surface is cambered, but further experiments made after the pictures were taken indicate that it is more effective if built flat; therefore it is recommended that it be made this way. A simple push-rod linkage is used to hold it in any desired position.

A word of caution: It is frequently desirable to enlarge plans of conventional model planes above the size recommended by the designer and this is often done with good results. But this procedure or any other alteration of the plans must be discouraged by the writer as regards *Hoverbug* because to do so may result in an unflyable machine. This is because weight distribution, articulation problems, and power requirements may be greatly modified by a size increase.

Begin construction with the fuselage which is built on the plans (presented full size). The structure is strictly conventional except that it becomes triangular aft of the rotor tube location. The fin may be integral or built separately. Use 1/16" hard balsa strip for all members. The rotor tube mounting plate is a bit of sheet balsa to which a reinforcing washer has been centered and cemented. Cover windows with cellophane, and balance of the fuselage with tissue. Water shrink but do not dope.

The control surface is next. For the lower spar, which is also the wheel axle, use a length of 1/8" sq. basswood or very hard balsa as this piece must sustain landing shocks. Tissue cover and pin flat when shrinking. A small hardwood block is fastened to the center of this piece with a liberal quantity of cement. (See detail sketches.) This block is pierced with a pin and linked to a similar block cemented to a length of 1/16" hardwood dowel. Attach the control surface to the rotor base plate with cloth hinges as shown. A small block of soft balsa is drilled to fit the 1/16" dowel tightly; it is then slid over the dowel and cemented to the fuselage. The control is adjusted by sliding the dowel fore or aft and the control surface should depart 45° from the vertical in either direction.

Use pin axles to attach two hardwood wheels to the ends of the control vane. The front wheel is made by cementing together two more wheels of the same size and attaching them to the nose block by means of a wire yoke.

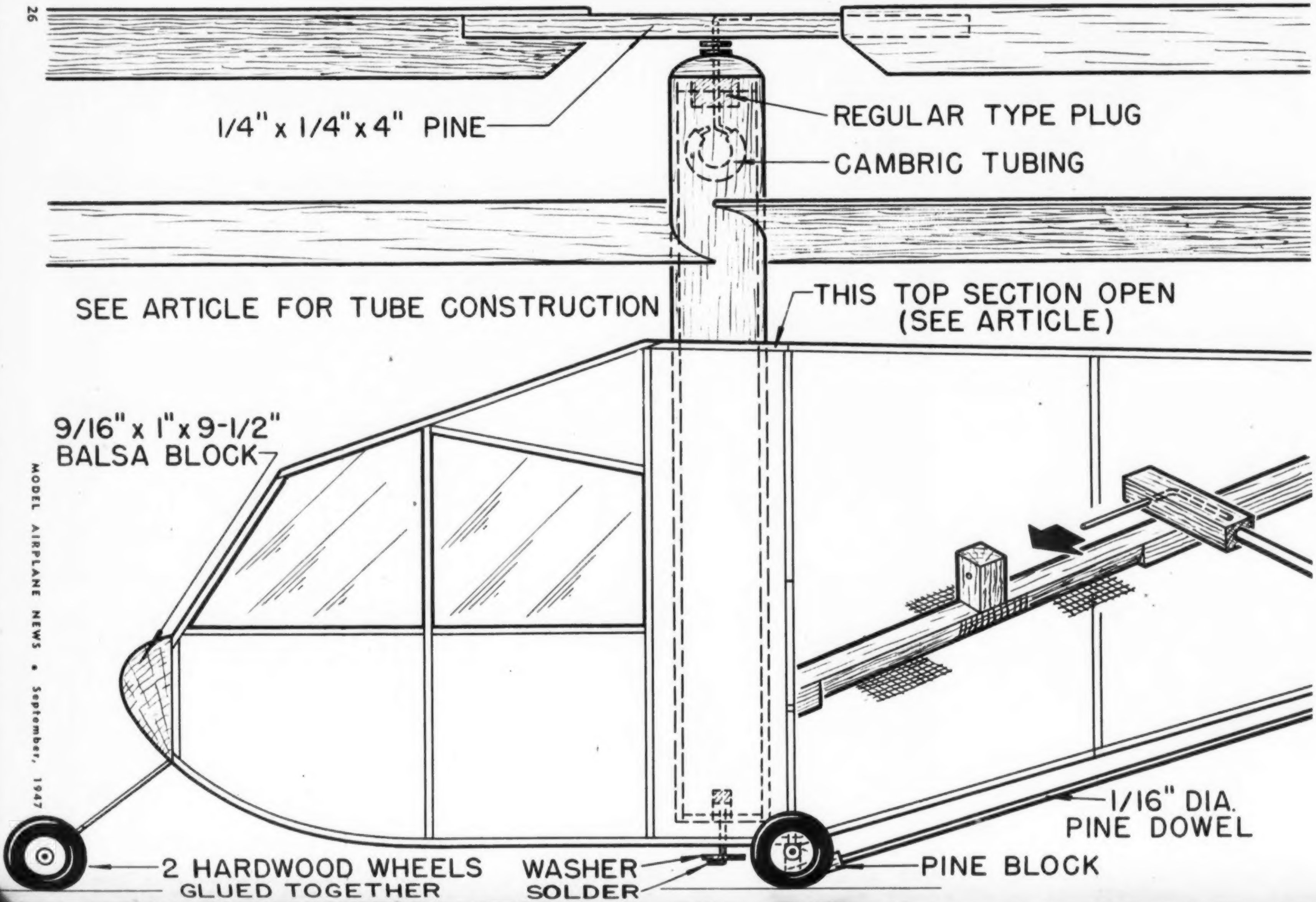
The rotor tube is formed from a 6" length of 1/16" medium soft balsa sheet, soaked in hot water, wrapped around a dowel, and held in place with gauze. Permit it to dry thoroughly before removing and cementing up the seam. The upper end of the tube is plugged with a disk of 1/8" hard balsa drilled to accommodate a standard hardwood thrust button. Cut out and reinforce two notches in the lower end of the tube to hold the lower rubber anchor which is a short length of hardwood dowel. Center a pin or piece of wire in another disk of 1/8" hard balsa, cement firmly in place and attach the disk to the bottom of the tube.

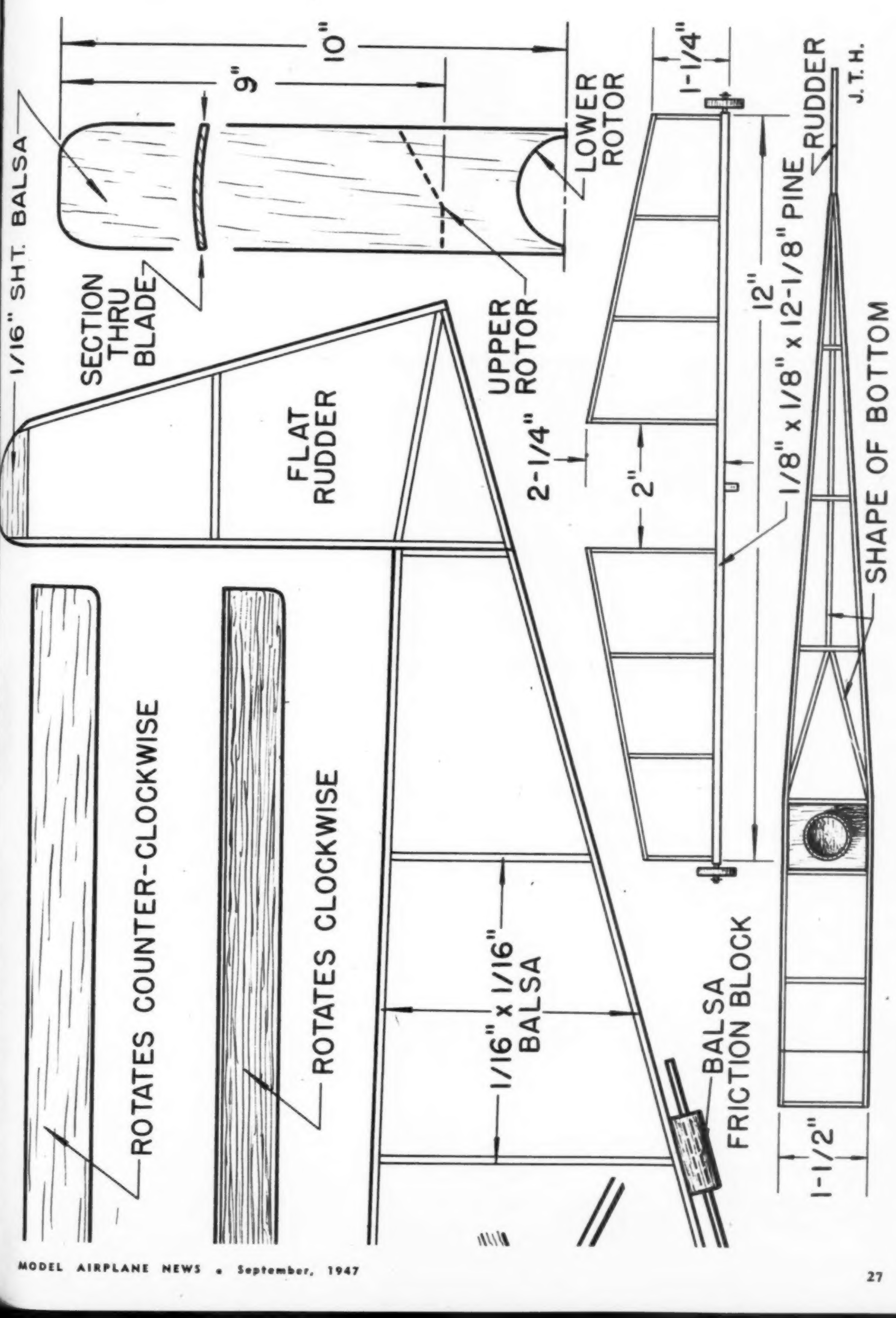
Next cut four rotor blades from 1/16" medium sheet and sand them over a bottle to produce a slight camber. The lower rotor blades are cemented directly to the motor tube at a pitch of 30° and with a slight negative coning (or dihedral) angle. Don't spare the cement on this assembly. The unit just assembled is tested for balance separately.

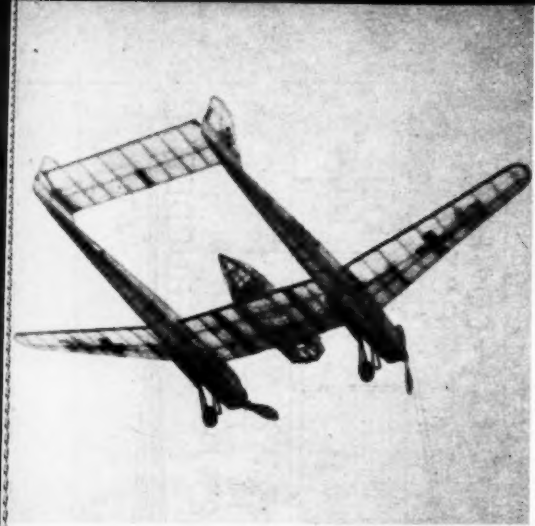
Build up the top rotor by cementing the two blades over the 1/4" sq. hard balsa hub piece at an angle of 35°. A wire hook, washer and thrust plug complete the assembly. Six strands of 1/8" flat rubber comprise the motor.

Drop the completed motor tube into place in the fuselage, poking the pin-axle of the tube through the reinforcing washer in the mounting plate and bending it over to hold in place.

Since there is no free-wheeling device this model is flown under power at all times, using residual power to brake its descent. It is best flown indoors and first hops should be of short duration. Balance should come just ahead of the rotor tube axis, but to secure maximum distance in forward flight it may be necessary to make the machine slightly nose-heavy. For forward flight slant the control surface rearward, just the reverse to fly backward. Experiment with varying degrees of power for best results. For outdoor flying greater duration can be obtained by using considerably more rubber and incorporating one of the reversing free-wheelers described in the writer's previous helicopter article in the May issue.


1/4" x 1/4" x 4" PINE
REGULAR TYPE PLUG
CAMBRIC TUBING
SEE ARTICLE FOR TUBE CONSTRUCTION
THIS TOP SECTION OPEN
(SEE ARTICLE)
9/16" x 1" x 9-1/2"
BALSA BLOCK
1/16" DIA.
PINE DOWEL
2 HARDWOOD WHEELS
GLUED TOGETHER
WASHER
SOLDER
PINE BLOCK


2 HARDWOOD WHEELS
GLUED TOGETHER
WASHER
SOLDER
PINE BLOCK
1/16" SHT. BALSA
9"
10"
SECTION
THRU
BLADE
UPPER
ROTOR
LOWER
ROTOR
FLAT
RUDDER
ROTATES COUNTER-CLOCKWISE
ROTATES CLOCKWISE
1/16" x 1/16
BALSA
BALSA
FRICTION BLOCK
2-1/4"
2"
1-1/4"
12"
1/8" x 1/8" x 12-1/8" PINE
RUDDER
J. T. H.
SHAPE OF BOTTOM
1-1/2"



No. 1 Flying scale FW-189 built in England by M. Garnett

# AIR WAYS

## News of model airplane experimenters from all over the world

WEST COAST TEAM CHOSEN.—As detailed in "West Coast Tips," page 34, the finals to select the Western representatives for the East-West Meet were held June 15 and the team members will have many hours of practice under their belts by the time this issue reaches our readers. The East Coast winners were scheduled to be chosen on July 26 and 27. Thereafter we presume not much will be heard from either side until the big days, Sept. 6 and 7 at St. Louis, when the finals will be held. May the best team win!

$CO_2$ NOTES.—As pointed out by Russ Nichols in his AMA column last month, the $CO_2$ powerplants fall in the category of rubber models, as far as contest rules go. We would like very much to hear from contest directors who have had experience in their own meets with these new power units.

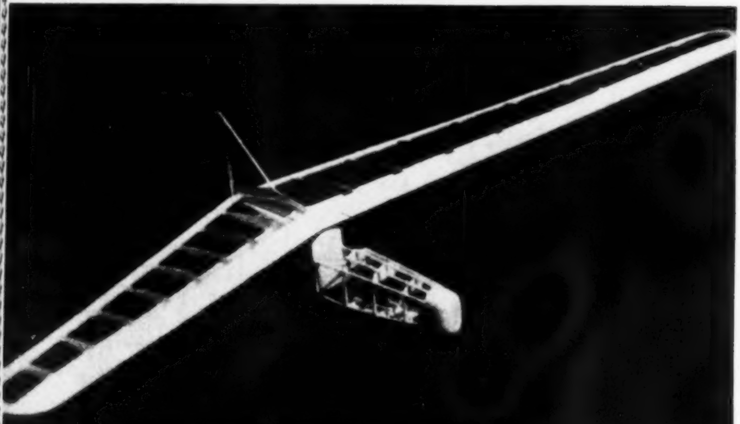
Incidentally, the old saying "There is nothing new" has been widely applied to aviation for many years, and it certainly is no better exemplified than in the case of this "new" source of power. Any doubters may turn to the September 1931 issue of MODEL AIRPLANE NEWS (if they can locate one!) where they will find a detailed article on the use of "Sparklet" cylinders to operate simple model engines!

There will probably never be a source of power available to model makers that some enterprising experimenter will not try to "soup up" in order to get more pep or longer duration. $CO_2$ power units are no exception to this, and we now hear that some fliers have gone so far as to put their cartridges in a fire just before installing them in a model. As expected, power was considerably increased, but these same fliers were probably greatly dismayed when the cartridges exploded with further heating. The explanation, of course, is simple: under normal temperatures the $CO_2$ in the cylinders is under a pressure of some 600 lbs. per sq. in., and when heated this pressure increases rapidly. Application of heat also weakens the seal on the cartridge, so it's no wonder heating is unsafe. Therefore, the only advice we can give in this connection is, *Don't Do It!*

Some experiments have been made on heating the pipe from tank to motor; this can do no real harm if care is taken to keep the heat away from the tank. A worthwhile gain in results can be obtained simply by soldering a number of washers to the feed pipe, as these washers absorb heat from the air which tends to keep the feed pipe from freezing.

A local flier gives us this tip to pass along; don't fail to follow the maker's instructions on oiling the motor after every few cartridges are run out. Aside from the necessity of lubricating the moving parts, the oil serves to protect the metal surfaces from rust. Every time the motor is run it gets very cold and, of course, moisture from the air quickly gathers on a cold surface. This moisture on the unoiled surfaces of your engine soon gets in its dirty work. 'Nuff said!

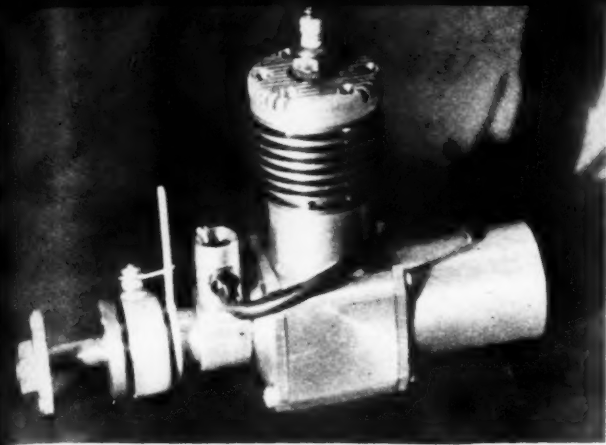
(*Turn to page 64*)



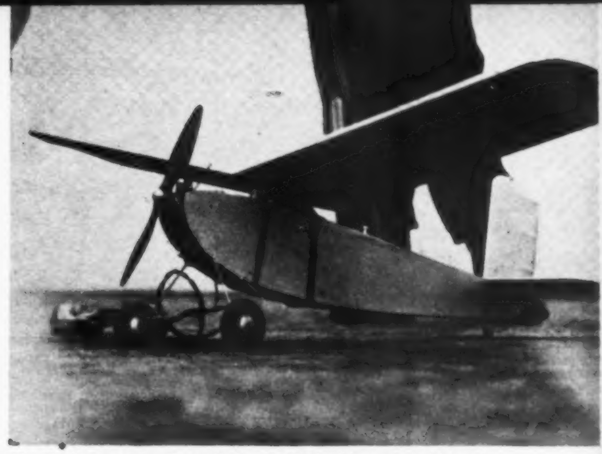
No. 2 Tailless glider was found to be a good flier after covering; by John M. Klover

No. 3 Ed Maloney built this non-flying Gotha bomber to a scale of ½"

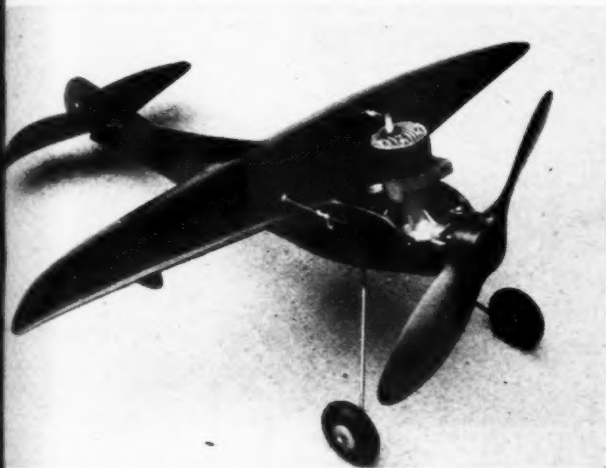
No. 4 *Wanderer* is a fine flier and was built from M.A.N. plans by Robert Villers



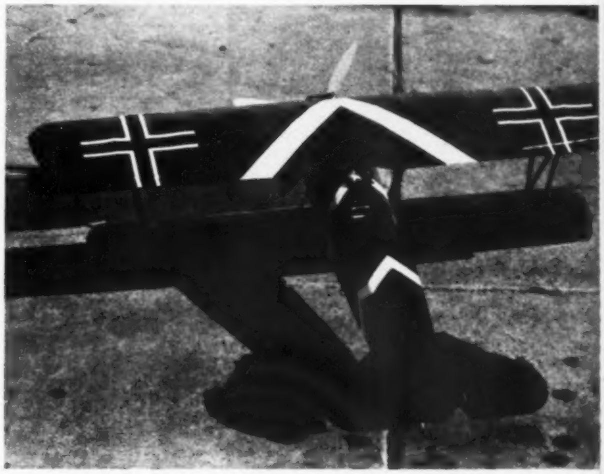
No. 5 This is the second successful *Simplex 25* built by Harold Herr



No. 6 *Atom* powered gassie from J.D.A. Sigmond in Holland

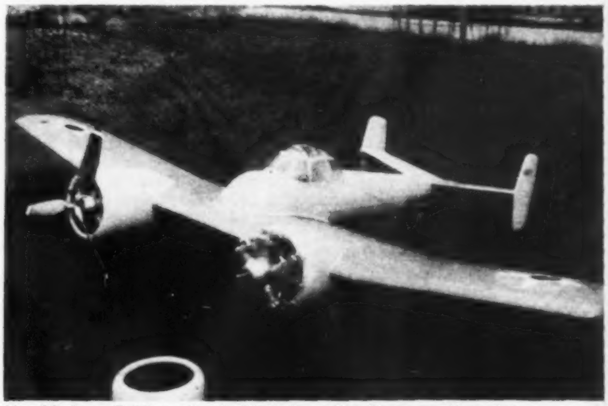


No. 7 This is *Super-Duper* produced by Alfonso Arantes in Brazil



No. 8 Control line Fokker D7 by Jim Hobson has had a highly eventful life

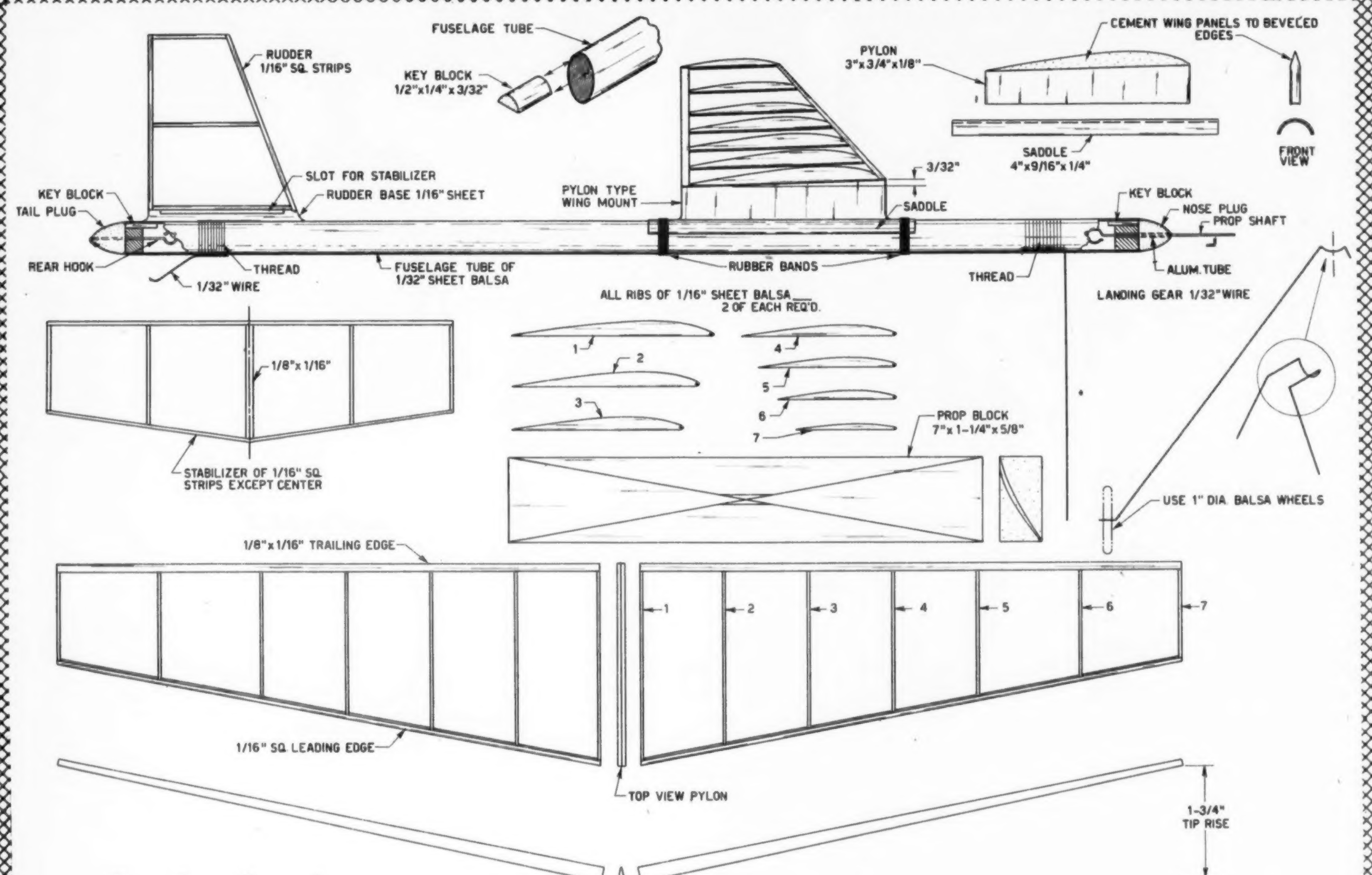
No. 9 Flying wing control job by R. B. Johnston has preven satisfactory



No. 10 Leon Tefft produced this twin engine Grumman *Skyrocket*

No. 11 "Swede" Wall holds his original powered by K & B *Torpedo*

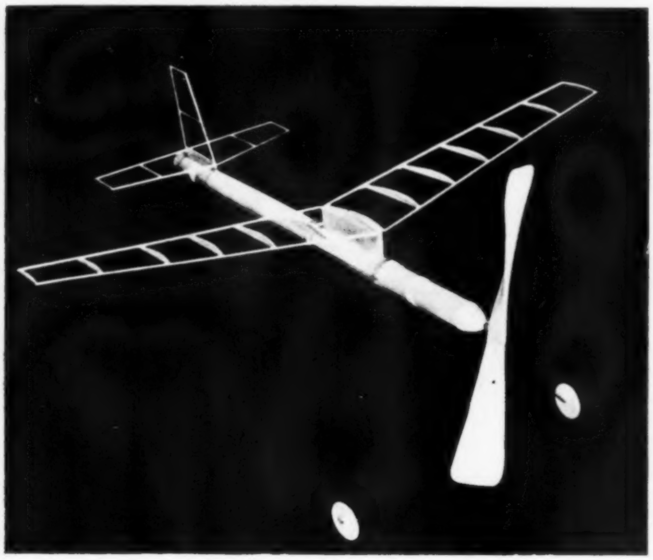
No. 12 Bill Featherstone from Canada built this neat free flighter

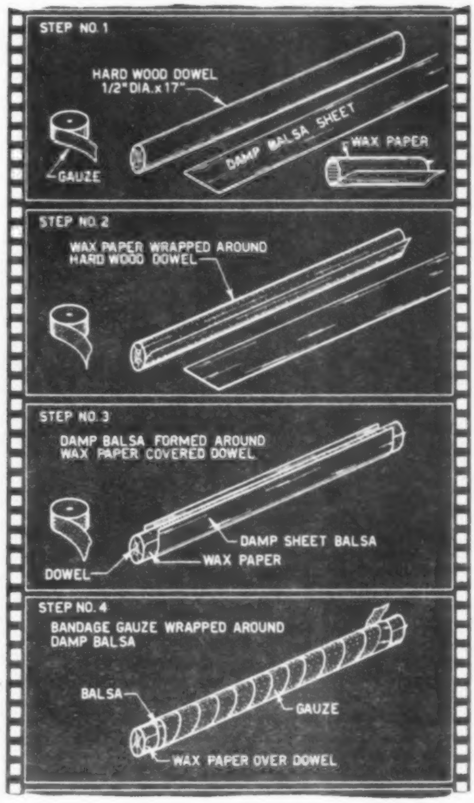


RUDDER
1/16" SQ. STRIPS
FUSELAGE TUBE
KEY BLOCK
1/2"x1/4"x3/32"
PYLON
3"x3/4"x1/8"
CEMENT WING PANELS TO BEVELED EDGES
SADDLE
4"x9/16"x1/4"
FRONT VIEW
SLOT FOR STABILIZER
RUDDER BASE 1/16" SHEET
3/32"
PYLON TYPE WING MOUNT
SADDLE
KEY BLOCK
TAIL PLUG
KEY BLOCK
NOSE PLUG
PROP SHAFT
REAR HOOK
THREAD
FUSELAGE TUBE OF 1/32" SHEET BALSA
RUBBER BANDS
THREAD
ALUM. TUBE
1/32" WIRE
ALL RIBS OF 1/16" SHEET BALSA 2 OF EACH REQ'D.
LANDING GEAR 1/32" WIRE
1/8"x1/16"
1
2
3
4
5
6
7
PROP BLOCK
7"x 1-1/4"x 5/8"
STABILIZER OF 1/16" SQ. STRIPS EXCEPT CENTER
USE 1" DIA. BALSA WHEELS
1/8"x1/16" TRAILING EDGE
1
2
3
4
5
6
7
1/16" SQ. LEADING EDGE
TOP VIEW PYLON
1-3/4" TIP RISE
0"
1"
2"
3"
SCALE
WING MOUNT PYLON

# MODEL AIRPLANE COURSE FOR BEGINNERS

**A CAREFULLY PLANNED AND TESTED SERIES OF ARTICLES FOR BEGINNERS IN THE ART OF BUILDING AND FLYING MODEL PLANES**



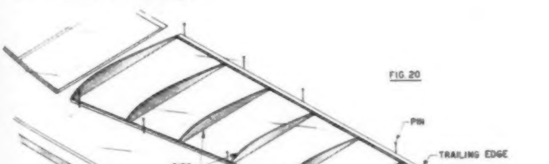



### LESSON 5—*Try this built-up stick model*

THIS lesson describes the technique for building the model shown in Fig. 18, a typical built-up or framework construction for an R.O.G., with tube-like stick completely enclosing the rubber motor.

**Materials Required.** 1. A sheet of 1/32" thick balsa for fuselage tube.

2. A piece of 3/4" sq. x 2" balsa for nose and tail plugs.
3. One strip of balsa 3/32" thick x 1/4" wide for key blocks.
4. Medium hard balsa strips 1/16" sq. for tail frame and wing leading edge.
5. One strip of medium hard balsa 1/16" x 1/8" for wing trailing edge.
6. One sheet of medium hard 1/16" thick balsa for wing ribs.
7. A piece of hard balsa 3" x 3/4" x 1/8" for wing pylon.
8. A piece of hard balsa 4" x 9/16" x 1/4" for wing mount saddle.
9. A medium hard block of balsa 7" x 1-1/4" x 5/8" for the propeller.
10. A pair of 1" dia. balsa wheels.
11. A length of 1/32" dia. music wire for landing gear, propeller shaft, rear hook and tail skid.
12. One piece of aluminum tubing for thrust bearing 7/8" long and 1/16" outside diameter. (Inside diameter to take 1/32" wire without binding.)




13. A small bead (or 2 washers) to be used on prop shaft.
14. About 5 ft. of 1/8" flat brown rubber for power and wing fastening.
15. A sheet of light model airplane tissue for covering wing and tail surfaces
16. A bottle of clear dope.
17. A small tube of model airplane cement.
18. A spool of thread.

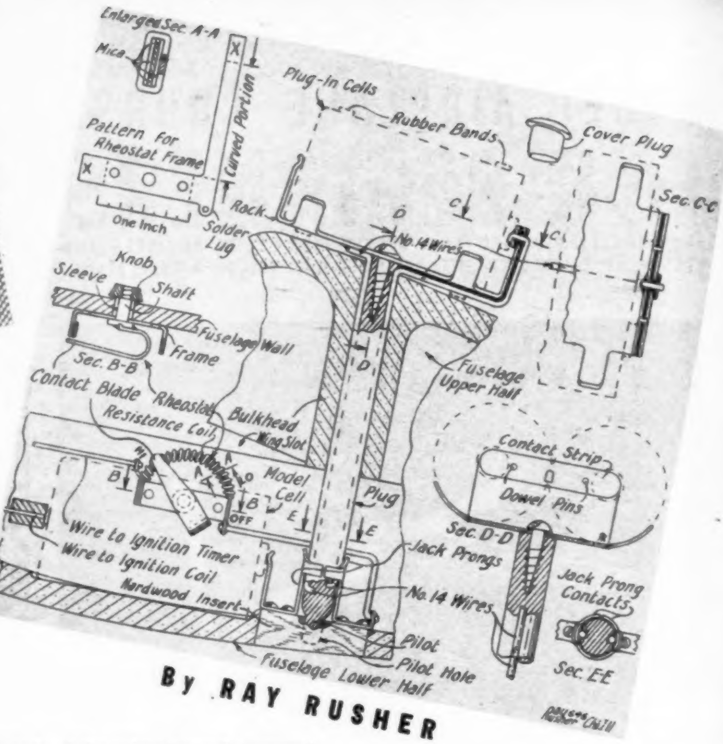
**Tools Required.** 1. A hardwood dowel 1/2" dia. x approx. 17" long; 2. wax paper; 3. bandage gauze; 4. small brush; 5. artists spray tube; 6. sharp knife; 7. razor blade; 8. long nose pliers; 9. wire cutting pliers or snippers; 10. package of varied grade sandpaper; 11. ruler; 12. pencil; 13. scissors; 14. pins; 15. carbon paper. With the exception of the first five items, used to form the motor tube and to spray the finished model, tools listed above are similar to those used for previous models. The hardwood dowel, if not available at your hobby supply center, may be purchased from any lumber yard or carpentry shop. The brush and spray tube are obtainable at any art shop.

**Constructing.** Half size plans are furnished, so it is advised that they be enlarged by any process desired, as described in Lesson 3. This is important because the wing and tail panels of our model must be assembled over the plans, as will be described later, in order to simplify building. Use carbon paper to transfer the rib contours from the plan to the balsa sheet.

**Fuselage.** The fuselage of our model consists only of a light sheet balsa tube. The tube is fabricated by forming 1/32" sheet balsa around a hardwood dowel as illustrated by the accompanying "film strip." First step consists of assembling the required materials for this operation: dowel, bandage gauze, wax paper and the balsa sheet. In order to make the balsa more pliable or flexible, so it will not crack when formed around the dowel, moisten it with hot water. After this has been done and the dowel has been wrapped in wax paper (step no. 2 of "film strip"), form the damp or wet balsa sheet around the dowel form as shown in third frame of the "film." When so doing, make certain the seam (edges of balsa sheet) is perfectly straight along the dowel. Care must be taken to eliminate any spiraling of this seam if a strong tube is to be had. After the edges of the damp balsa have been brought together, wrap the entire length of the stick with gauze as shown in step 4 of "strip", so as to hold the balsa in the desired tubular form.

*(Turn to page 60)*

# CURRENT SAVING IGNITION SYSTEM




By RAY RUSHER

TO eliminate the necessity of carrying a heavy booster battery about the flying field, and at the same time have adequate ignition current for starting and minimum current drain for running, the plug-in cell and rheostat combination shown has been found very useful. The cell in the model is a single large flashlight cell (size D), and to start the engine a second pair of cells is plugged *in series* with the model cell. A rheostat is mounted in the model and connected in series in the current supply circuit and set at maximum to start the engine.

Most rheostats commercially available are too large and heavy for models. The drawings show one that you can construct. It is very light yet has sufficient capacity for the desired control of two flashlight cells in series which is the maximum it will be called upon to handle.

The rheostat consists of a frame, a resistance coil, a screw serving as a shaft, a contact blade soldered to the shaft, a sleeve soldered to the frame to serve as a bearing for the shaft, and a knob of wood or plastic on the outside of the fuselage wall. The frame is an L-shaped piece of tin or brass cut to the pattern shown and bent on the dotted lines. Note that one leg of the L is narrow and the other wide.

Before bending the curved part of the narrow leg, slip the resistance coil on it. The coil is formed by winding 18" of No. 21 *Nichrome* wire around a hardwood stick or metal bar 3/64" thick and 1/4" wide. This will amount to about 25 turns. Fill the space between the narrow leg and the coil with two 3/64" strips and two 1/4" strips of mica about .015" thick as in Sec. A-A. The mica insulates the coil from the frame with a type of insulation that will not burn when the coil gets hot and yet weighs very little. Then bend the curved portion around a broomstick and solder the two ends of the legs together at the points marked X on the pattern.

Circuit connections are made to a solder lug of the frame and to one end of the resistance coil. Cement the ends of the coil and the mica strips to the frame to prevent shifting of the coil when the rheostat knob is turned. Two of the holes in the wide leg of the frame are for receiving cement or small screws to anchor the rheostat to the fuselage wall.

The plug-in rack consists of a plug formed of a 3/8" dowel and a sheet metal rack mounted on its upper end. Front and back of the dowel are grooved to receive two No. 14 enameled copper wires which are cemented in place.

The upper end of one wire is soldered to the rack and the upper end of the other wire is soldered to a contact strip suitably insulated from the rack by strips of insulation shown black on the drawing. A pair of hardwood or fiber dowel pins cemented in place keep the contact strip in proper alignment relative to the rack. The lower ends of the wires have the enamel scraped off to make connection with the two prongs of a jack, and the lower end of the dowel is reduced in diameter to enter a hole in a hardwood insert to act as a pilot for the plug relative to the jack.

Any suitable guide means for the plug can be provided. The drawing shows installation on a *Fireball* which has a thick bulkhead in the upper fuselage half through which a 3/8" hole can be drilled and then slightly enlarged by means of sandpaper wrapped around a dowel so that the plug will slide easily through the hole. This hole can be closed by inserting a cork or a cover plug during flight.

The jack itself consists of two jack prongs of spring brass mounted on the hardwood insert by means of screws. One prong is connected by a wire to the rheostat and the other forms a contact for one end of the model cell. Both prongs are provided with C-shaped contacts that engage each other when the plug is pulled out and are separated when it is plugged in.

To use the system, after the engine is started from the model cell and the plug-in cell in series, and has warmed up slightly, the rheostat is turned down to a point just above where the engine starts to miss. After the engine is warmed up the rheostat is turned up again and the plug-in cell pulled out, which makes a connection at the jack prong contacts so that the ignition circuit then operates on the model cell alone. The rheostat is now turned down again to supply only minimum requirements of the ignition circuit for satisfactory operation of the engine. If the engine run is to be of considerable duration, don't turn the rheostat down too much or the model cell current will weaken to a point where the ignition fails before the end of the run.

The advantages of the rheostat are that it conserves cell energy and conserves the points of the ignition timer and sparkplug. Supply of current above minimum requirements causes excessive spark coil heating, and excessive sparking and therefore burning of the timer and sparkplug points.

Connect an ammeter across the timer terminal and ground when the engine is stopped with the points in open position, and the amperage available for starting can be determined by turning the rheostat full on. This test includes the spark coil in the circuit and accordingly doesn't cause excessive drain on the cells as would a direct connection of the ammeter across the cells alone. By turning the rheostat down to a point just above where the engine starts to miss and then stopping the engine and checking the amperage across the timer terminal and ground, the minimum current for running can be determined.

For most of the better grade spark coils, a 2-1/2 or 3 amp. test of the model cell and the plug-in cell is satisfactory for starting. On the model cell alone the test should be 1-1/2 amp. for running, although some coil and engine combinations require slightly more and undoubtedly more efficient coils will be developed that require less.

As for testing cells when you buy them, the usual test (as to whether or not they will light a flashlight bulb) is no good whatever as far as cells satisfactory for model engine ignition is concerned. Use an ammeter such as one of the "Voltameter" or "pocket battery tester" type, but always be careful to remove the tester from the cell just as soon as a reading is taken as these testers cause considerable drain on any cell being tested. For size D cell, 10 amps. is considered good and some of them will go as high as 15 amps. when new and fresh. If tests are lower than 8 amps. the cell will run down too soon on a model engine ignition circuit to be considered satisfactory.

The rheostat also gives an indication of the condition of the cells, as when it has to be turned nearly full on for running, the cells are close to being run down to a point where they are no longer satisfac-

(Turn to page 79)

# WEST COAST TIPS

by JOHNNY DAVIS

WE JUST witnessed one of the most remarkable control line flight competitions it has ever been our pleasure to behold. The occasion was the Los Angeles Regional Precision Elimination Meet for the *East-West* shindig. The location, Rancho Cienega playground, "where the winds blow like Wichita."

There were only 15 boys flying that day and they had two circles with three judges for each circle. The contest started at 9 a.m. and was over at 12. There was a run-off in the afternoon that started around 2 and finished up at 4, so there wasn't a great deal of time to get much flying done compared to most contests, which start at 8 and end only when the sun goes down. But we have never seen such sportsmanship and high quality flying. We'll put you in our place for one flight, the first of the day, just to show you what went on right from the start.

You're sitting at the judges' desk with paper and pencil in hand. It is 8:58 and the sun is really "California" already. It is a beautiful day. Out into the circle walk Bob Keech and his backer Crawford, of the *Anaheim Balsa Butchers.* They run the lines down to make sure they are not kinked, then check fuel and batteries. Crawford comes over and hands us Bob's flight pattern consisting of: Starting, within one minute, takeoff, level flight for two laps, climb and dive (vertical), wing-over, consecutive inside loops, consecutive outside loops, inverted flight for two laps, horizontal figure eight, special maneuvers and landing.

That may look like a real mouthful or handful of flying for the average guy, but the above flight pattern was only used as a "school" pattern and was departed from in some respects for the run-off and other more difficult maneuvers run in. Suffice it to say that every man there was capable of the pattern listed above and then some.

Well, to get back to Keech—at a signal from the judges he starts flipping his motor. In about 45 seconds after having had his motor lean out and quit once, he is in the air with a nice smooth takeoff. His level flight is smooth, his climb and dive are both vertical, his wing-over is sharp, consecutive loops (wires must not exceed 60°—with ground) are fine, although some are right on the borderline for height. Outside loops are just a hair sloppy, but it seems to be airplane rather than Bob as the old crate he is flying just about won't stay in the air. Inverted flight is smooth for two laps; his horizontal eight is just a shade too big, and you can see the judges catching him for that mistake. Next maneuver is Bob's special; for this flight he is attempting to break a balloon at the bottom of an

Keith Storey with McCoy 49-powered Class V ship that set official record of 124.88 mph at Los Angeles Aero-Modelers last May

outside loop. He will only get points if he does it the first time he tries it. His partner Crawford is now setting the stick, with a balloon tied to it, on the edge of the circle in an upright position so that the balloon is about 24 in. from the ground.

After several level laps in which they checked the balloon's position, Bob raised his hand and turned his plane upside down. He made a level high upside down lap and then lowered the plane to about 3 ft. As he passed over the balloon he started his outside loop. Up and over it was swell, but it was a little too big, and he came out at the right height but about 5 ft. in front of the balloon, and before he could change and get the balloon he was past it. It is hard to describe the tension that builds up when you are watching all the preparations, and then see such a near miss (not only missing the balloon either—he only cleared the ground by about 12 in.).

But the capper was that Bob was dissatisfied with his performance and tried to get the balloon five more times, with the rest of us waving wildly and yelling for him to quit before he wrecked the airplane. Then his engine ran out of gas and he made a nice landing.

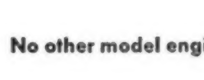
This was just a typical flight though, nothing extraordinary about it at all; yet

(*Turn to page* 72)

Ken Aymar (left) and his brother, Bill. Kenny, shown here with his pet model (an S.E.5), will be a judge for Precision flying at the East-West meet

# In a class by itself . . .

*The* **BURGESS** *M-5*
*5 Cylinder*
*Miniature Engine*



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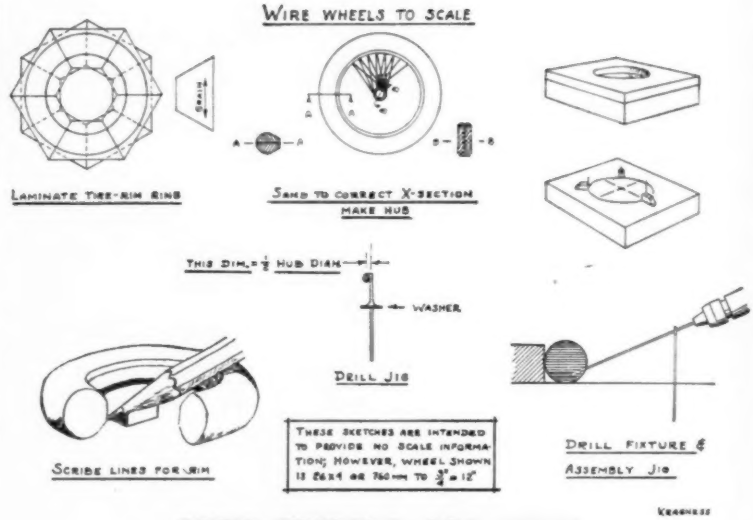



# WIRE WHEELS ARE EASY

**by N. L. Kragness**

WE KEEP seeing otherwise beautiful models of the 1909-1930 period appearing with solid wheels—true some are correct, but most are not. Until the first world war, wheels were always wire spoked and usually of the bicycle or motorcycle type. As soon as airplanes got under production for that first fracas two classes of wheels appeared—the fighter wheel of the allied powers turned out to be an invariable 26 x 4 size, or 760 mm. x 90 mm. Tires were interchangeable and most used 1.5 or 1.75 steel tube for axle with bronze bushings to adapt to the wheel hub size. The central powers seem to have used the same general size for fighters.

Both sides occasionally used special sizes on specially sized airplanes, and often the wire spokes were hidden by making a fabric wheel envelope and doping it to hide the spokes and fair the wheel. Fokker airplanes, of course, used wheels as end plates on a small axle wing, which eliminated the tip losses and made the little wing of real value. Thus we have fabric or very thin aluminum covers for the wheels. In service they were easily damaged and the quickest "repair" was to tear 'em off and throw 'em away. Therefore we often had one open and one covered wheel on the same airplane! Not neat, but that's the way it was usually!

Now this trick of a standard wheel size was the reason our 1920 to 1932 airplanes were equipped with 26 x 4 wheels and tires. Postwar conditions then resulted in the sale of these heavily produced wheels at trifling prices. The writer bought 'em for $12 a pair, new; and that was with tubes, casings and bushings. So we find the Waco open airplanes, 9, 10, taper wing, all with 26 x 4 wheels of wire; similarly, *Travelair 2000, 4000* series, also *American Eagles, Eaglerocks, Rearwin* biplanes, *Commandaire, Stearman*, an occasional *J-5 Vega*, the *OX-5 Robin*, etc., in fact everything with *OX-5, Hisso, J-4 power.* Another was the Ford powered *Pietenpol* light plane.

Let's spend a couple of extra hours with some scraps and have realism. You'll find 'em strong and light. First, we'll laminate the tire-rim ring for strength and economy; scraps will do, and while the drawing shows neat hexagonal segments they needn't be if they approximate it and have neat tight joints.

If the builder has access to a lathe the job is a little neater—and a little more trouble. If not, don't worry. With a compass layout the outer and inner diameters, trim neatly and sand to circular shape with care. By laying your wheel near the worktable corner, using a sanding block and rotating the work, you'll find amazing tire contour accuracy possible. Three jigs are shown and all work well, depending on the care you use.

Using a very soft and sharp pencil, mark the rim centerline and rim edges as shown in the sketch; then with a protractor divide each rim into 24° segments so they are alternate. Set your tire and rim ring in the jig, and using the wire drilling guide drill with with a No. 80 drill or sharpened No. 14 piano wire, taking care not to drill entirely through.

Our hub is next made by drilling a small length of appropriate sized dowel for our desired axle. The end diameter is reduced to avoid a crowded look when the spoke ends are all attached. Mount the hub on an axle stub in your jig. Tire and rim should be painted *before* spokes are installed. Spokes are bamboo splints, scraped smooth and painted silver *before* assembly. Tweezers are useful and cement should be used sparingly. Complete with small paper or celluloid discs glued to end of hub just large enough to cover spoke attachments.

## *TWIN MOTOR CO-2 PLANE!*

**The new CO-2 powerplants lend themselves well to multi motor design. The October issue of MODEL AIRPLANE NEWS will present plans for a Twin and also for a rechargeable tank to go with it. (This is a contest type job by Frank Ehling.) Don't miss this exclusive feature in**

**October MODEL AIRPLANE NEWS**
*On Sale Everywhere Sept. 9th*

# AIR CLEANER FOR MODEL ENGINES

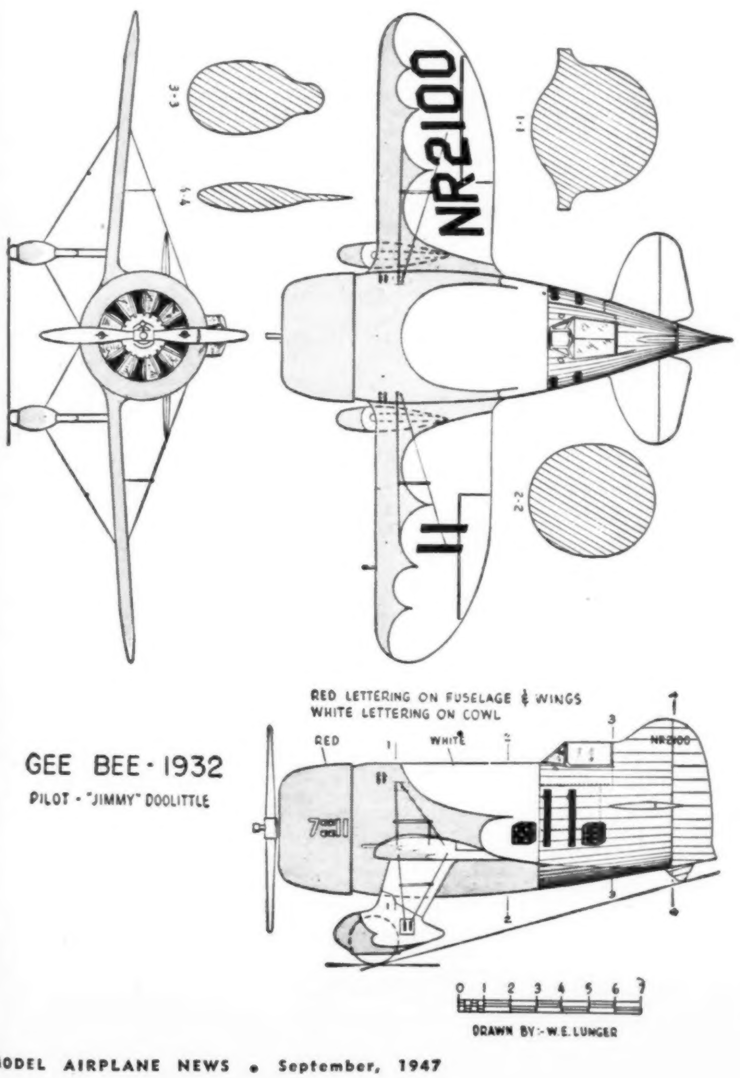
**By RAY RUSHER**

A SIMPLE air cleaner for model engines is not at all difficult to make. It will lengthen the life of your engine considerably, especially if it is operated where dust is in the air, and apparently clear air always has some dust present. Here's an air cleaner that clamps onto the intake tube and has a built-in choke valve so that the cleaner doesn't interfere with choking the engine.

The housing for the air cleaner consists of a tube section, a cone section and a cylinder section—each made of tin plate. The rectangular piece of tin from which the tube section is made should be about .002" shorter than required to completely encircle the intake tube and is clamped to it by an aluminum clamp band and a small bolt. The cone section is soldered to the tube section (while the tube section is clamped on the intake tube to insure an air tight fit).

The cylinder section is soldered to the cone section with a fine screen of about 30 mesh inserted at the junction of the cylinder with the cone. Wool fibers are packed against the fine screen and held in place by a coarse screen of about 8 or 10 mesh, such as ordinary fly screen. Wool fibers of the kind used in pneumatic thermostats are best, although those produced by pulling and combing wool yarn apart are a satisfactory substitute. Oil the fibers with a teaspoonful of No. 20 or 30 lubricating oil to catch and hold the dust.

The coarse screen is held in position by a cap secured to the cylinder section by means of a pair of metal-piercing screws. The cap may be cut from a metal or plastic bottle cap of the screw type or made from a flat disk of brass with a narrow strip formed into a ring and soldered to the periphery of the disk. Still another method is to turn it from a disk of plastic about 3/16" thick. The diameter of the cylinder and cap should be 2½ or 3 times that of the intake tube (interior diameter) to provide an area in the cylinder of the air cleaner which is 6 to 9 times as great as the area of the intake tube. By running the engine with and without the



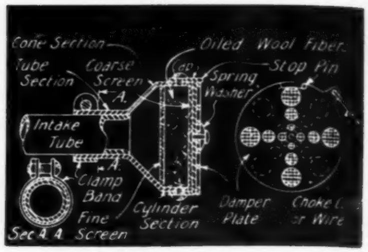

GEE BEE - 1932

PILOT - "JIMMY" DOOLITTLE

cleaner installed, no difference will be noted in its speed if this proportion of areas is maintained, as the air cleaner then permits sufficient air flow to avoid any choking effect on the engine.

The choke valve consists of a damper plate pivoted to the cap, the plate and cap each having openings as shown in the drawing to match each other for normal running operation or to be staggered in relation to each other for closing off air to the air cleaner when it is desired to choke the engine. The damper plate has limited movement relative to the air cleaner and a return spring tends to keep it in the non-choke position. A choke cord or wire may then extend to a convenient location outside the fuselage for controlling the choke valve from that point. The choke cord or wire permits choking of an engine which is so installed in the plane that its intake tube is relatively inaccessible for choking by the usual method of placing a finger on the open end.

Surfaces of the cap and damper plate which engage each other must fit perfectly to prevent leakage during the choking operation. This is accomplished by "lapping" them until they are each truly flat. After the round openings are drilled in them, they may be filed out to the sector shape shown by dotted lines in the right hand drawing if you want maximum size openings. Then lay coarse emery paper (No. 200 or 300) on a flat surface such as a piece of plate glass and drag the cap and then the damper plate across it until the emery paper has contacted the entire surface of each and has removed all the high spots. If the cap is painted or enamelled, be sure to remove all such finish before lapping, by scraping and




then by means of the coarse emery paper. Finish with fine emery paper (about No. 600 or 700).

Now place a paste of emery flour and light machine oil on a flat metal surface and use this to lap the surfaces of the cap and damper plate. Lapping is done by placing the cap on the pasted surface and then rubbing it against the surface with a figure 8 motion rather than in a straight path back and forth. This removes all scratches and produces a highly polished surface if done properly. Move the cap by placing one finger on it at the center so that the surface being lapped will seek its own level against the lapping surface to which the paste has been applied. Don't grasp the cap at the edge as this may result in an uneven distribution of pressure and a finished surface that is not flat. The damper plate, of course, is lapped in the same manner as described for the cap.

When the air cleaner gets dirty, merely rinse it out in gasoline or naphtha and re-oil. The wool fibers of course can be readily renewed if the occasion arises, by removing the cap and the coarse screen.

## Plane on the Cover

(*Continued from page* 17)

is an 8-ton extension of the scale we'll discuss later, but suffice it to say that Grumman's 2-4-6-8-ton punch represents hardheaded planning in an aircraft world of scattered shots that are bringing their marksmen to grief in a growing competitive market.

The *Mallard* is designed for the wealthy private owner and the commercial operator, either scheduled or non-scheduled, to provide both land and water operation of an airplane. In addition to this obvious advantage, proponents of the amphibian point to increased safety of the type through its ability to make landings on lakes or other water bodies or on land under emergency conditions. The stronger hull of the amphibian, as compared with the landplane, provides greater safety margin in the event of a forced landing in hills or rugged country. Opponents of the amphibian point out that it uses a flyingboat hull, thereby eliminating the necessity for a weighty wheeled landing gear, and then adds this landing gear, thereby defeating its own purpose. Grumman, however, has proved in the *Mallard* that careful attention to weight-saving through proper design can provide an amphibian that performs equally as well as its equivalent landplane counterpart.

The *Mallard* is the first Grumman amphibian equipped with a tricycle landing gear, an innovation that might have been impractical on the comparatively small 2 and 4-ton predecessors. The main gear folds into the sides of the hull flush with the surface, the vertical strut breaking and folding inboard to merge with the wing and hull lines. The nose wheel retracts into a watertight compartment in the extreme nose of the airplane.

The powerplants are two Pratt & Whitney *Wasp* engines of the new H series developing 600 hp at 2250 rpm for takeoff and delivering 550 hp at 8000 ft rated altitude. These are mounted in simple, well shaped nacelles located within the wing leading edge, a position aerodynamically superior to either over or underslung locations. All air intakes are located within the cowl, another superior practice.

The most advanced design practice has been used in the Model 73's hull, chief of which is the use of a higher length-beam ratio than either preceding model. Research has proved graphically the advantage of higher "fineness ratio" hulls through a reduction in aerodynamic drag in the air. These new hull lines include a deep flare which permits quicker takeoff and smoother landings. This design also produces a minimum of spray and offers low hydrodynamic drag on the water during calm-water takeoffs.

Pilot and co-pilot (or extra passenger) are located forward of the wing and provided with dual controls of the wheel type on a single pedestal. The throttle, flap and landing gear controls are suspended from the cabin ceiling for convenience and as a safety measure to reduce the chances of accidental movement. The co-pilot's control arm is detachable to permit entrance to the nose compartment for conducting docking operations or handling mooring lines. A new feature—dual radio controls—is mounted on the coaming and provides ease of ac-

cess and little or no danger in the event of a crash landing.

A variety of cabin arrangements may be fitted, but the standard should please the most discriminating. This includes a forward and aft cabin compartment. The forward section contains 2 large facing divans, the middle portion of which is removable to permit a card table or desk to be installed. Each divan accommodates 3 passengers maximum or a total of 6 in the forward cabin. The aft compartment is fitted with 4 standard airline seats mounted 2 on each side of the aisle, bringing total passenger accommodations to 10. Aft of these seats is a dressing room with lavatory, mirror and toilet. Farther aft is the baggage compartment, which is accessible during flight. Recessed fluorescent lamps are used for cabin lighting, and built-in smoking stands and a refreshment cabinet are also provided.

The *Mallard* is the first amphibian to pass the new Civil Air Regulations tests for full Scheduled Air Carrier Operations rating. It is equipped with a full range of special safety devices including dual hydraulic brakes, two hydraulic engine-driven pumps with an emergency hand-pump, and automatic fire detection and extinguishing equipment. A Janitrol heating system is used, operated by ram air pressure while in flight and by a small blower unit while on the ground. Anti-icing and de-fogging equipment is provided for the windshield.

Specifications of the *Mallard* indicate it is the only airplane of its kind in the world. It has a wingspan of 66 ft. 8 in., is 48 ft. 4 in. long, and stands 19 ft. 4 in. high. Wing area is 444 sq. ft. It weighs 9220 lbs. empty and 12,500 lbs. fully loaded, indicating a useful load of 3280 lbs.

Performance of the *Mallard* is its chief claim to customer appeal for it has a top speed of 215 mph and cruises at 180 mph at only 55% rated power. It climbs at 1320 ft. per minute. An amazing performance is the fact that it can climb to 10,000 ft. on one engine! It has made repeated single-engine takeoffs at full gross weight of 12,500 lbs., proving it one of the safest airplanes in its class in event of an engine failure.

Range of the *Mallard*, like all airplanes, varies with its load. With 8 passengers and 300 lbs. of baggage, its range is 695 miles cruising at 180 mph. With 6 passengers and 200 lbs. of baggage, its range is 1030 miles. With 5 passengers and 55 lbs. of baggage it can fly for 1228 miles without landing.

Its price tag reads $115,000. For scheduled operations, it might prove ideal for regular service along Lake Michigan, for example, or along the New England coast, including numerous river and inland lake stops. For non-scheduled operation, the *Mallard* could easily perform trans-continental service routed along the innumerable suitable lakes dotting the route.

Orders continue to add to Grumman's backlog on the *Mallard*, which is now in quantity production in Plant 2 at Bethpage, L.I., N.Y. A large percentage of orders are from corporations which plan to use the craft as a flying executive office between plants and sales territories.

Still waiting to hear about that 8-ton job? Well Grumman is not talking about it yet other than to reveal it as a Navy project with 85 ft. span and carrying 20 passengers, or an equivalent (about 2-tons) of cargo. It is well along and is another step in Grumman's careful program of using all the lessons he learned in the design, construction and flying of a previous model in the design of a new model.

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## Helicopter Principles

*(Continued from page 15)*

found when it was noticed that the plane of rotation of the blades tended to slant almost immediately when the mast was planted. (Blades tend to remain at right angles to the mast.) This quick following action was considered to be the cause of initial instability since it introduced a sidewise component in the lift force, tending to move the machine from its initial position. Moreover, since this sideways force was applied above the CG of the model, it caused the ship to rotate longitudinally about its center of gravity thereby increasing still further the slant of the mast. As the slant increased, the forward velocity increased. With rotor blades having a fixed angle of pitch with respect to hub, forward velocity gave more lift to the advancing blade which put a force or couple on the mast, opposing the continuation of tipping and creating the swinging motion mentioned above.

The explanation for the immediate rotor following of the mast when the latter is tipped, a characteristic of hinged rotors, is found in the isolation of two forces: the aerodynamic and gyroscopic forces that rotors are subject to when the mast is inclined from vertical. Assume the helicopter is flying tipped forward; now, when one of the blades passes a point at right angles amidships to the flight path of the aircraft, it has say 9° of positive pitch relative to the airstream. When this same blade passes a point directly in front of the aircraft, this relative pitch has decreased due to the forward slant of the mast and the fact that the blade angle is fixed with respect to the hub. Thus the advancing blade tends to lift more at right angles to the flight path than when it is lined up fore and aft with this path. This tendency acts as an exciting force on the rotor and gyroscopic precession manifests itself by a force at a point 90° to the exciting force or at a point where the blade passes directly in front of the aircraft; thus the blades are compelled to rotate at 90° to the mast.

A restatement of this gyroscopic action may help, because this is one of the most misunderstood facts of rotary wing flight. Mr. Young observed that with a two-bladed rotor, since the advancing blade received more lift, the tendency would be to tip the rotor up on the advancing blade side and down directly opposite on the other side of the disc, a simple see-saw action. However, the blades are rotating, therefore forming a gyroscope, and the laws of gyroscopic action must take effect; a gyroscope when pushed down on one side will tip in a direction 90° from the exciting force. Imagine the face of a clock to be the spinning gyro. Now, if you press the gyro down at 9 it will come up at 12. There will be little movement at 9 or at 3 and a large precession movement at 12 and 6. The change in pitch angle of the blades with the mast inclined is produced because the blades were fixed in the hub and could not rotate about their spanwise feathering axis. Therefore, when the rotor tipping reaction was 90° from the direction of mast tipping, the rotor was forced to assume an angle different from that when the blades were in line with the axis of the tipped mast.

This might be explained another way: consider the rotor as a disc pivoted at right angles to the mast. With the disc stopped, a sideward slant of the mast will also slant the rotor sideways. With the

rotor revolving however, if the mast is slanted sideways the rotor disc, due to gyroscopic action, would tend to tip forward (or back, depending upon the direction of rotation). In spite of the hinges that allowed the blades to flap up or down and supposedly independent of mast tipping, the aerodynamic forces were resisted by gyroscopic action of the rotating blades. The combination of these forces steer the blades into a new path perpendicular to the mast because, as was explained, the gyroscope precesses or moves at a point 90° in the direction of rotation from the point at which a force is applied.

Arthur Young felt that if the plane of the rotor did not tip with the mast, greater stability could be obtained, since the lifting force would not then have a sidewise component in the direction of mast tip. To this end a rotor mounted on the mast by means of a universal joint employing gimbal rings, with the outer pivoting pins in line with the rotor blades, was constructed. Weighted arms were installed at 90° to the main rotor blades and the gyroscopic action of these arms served to keep the blades from rotating aimlessly about their spanwise axis. This rotor followed the mast very slowly and hovered with stability in still air. In a wind, however, the rotor would tip back opposite to the direction of the wind and the model would start to travel downwind. This rotor was called an "independent" rotor because the angle of attack of the blades is not influenced by the angular displacement or tipping of the mast.

This backward movement of the rotor plane in a wind made a new control necessary. Any attempt at control linkage attached either to the mast or the fuselage would destroy the "independent" quality of the universal joint hub and turn the rotor into a conventional hinged rotor following the mast or fuselage attitude. Mr. Young then deduced that if this rotor could be controlled from some point not dependent on the position of the fuselage or mast, stability might be obtained. This point of independent control was discovered to be the inertia furnished by a bar pivoted at right angles to the rotor span and allowed to flap independent of the mast. Since this bar is free to pivot about an axis lying in its own plane of rotation and perpendicular to its longitudinal axis, it will not tip with the mast but will tend to rotate in a fixed plane due to its inertia increased by gyroscopic properties of rotating systems.

It is obvious that the stabilizing bar furnishes an artificial horizon or point from which rotor feathering could be controlled without the aid of the pilot and independent of the mast. The linkage between bar and blade control horn forms a parallelogram, so that as the mast tilts the bar remains in its original plane of rotation, holding the blades with the original angle of pitch. By introducing a mixing lever, hinged within the bar itself to the blade horn and connected to the pilot's control system, angle of pitch may be controlled collectively to vary thrust or cyclicly to control the direction of thrust, both actions taking place simultaneously if desired.

Cyclic control is a mechanism which varies the pitch of each blade individually. For example, every blade might be given increased pitch as it passed the rear of the machine, causing the helicopter to tilt forward. By increasing the lift at one point on the disc and decreasing it on the opposite, the pilot tilts the rotor and direction of thrust as desired. Collective pitch changes the thrust of the rotor

equally over the whole disc by shifting each blade the same amount (this amount remains constant as the blade rotates), thus pushing more or less air down from the rotor, and the ship accelerates in a direction parallel to the lift vector of the rotor, which vector is controlled cyclically.

Movements of the fuselage and mast are not transferred to the rotor; instead the rotor acts to restore the mast to its original position and to damp out the disturbing oscillation.

However, it was soon found that the very thing which created this inherent stability hindered good maneuverability. To have quick response to a control action, the fly bar or stabilizing bar must "follow" the tilt of the mast fairly rapidly and take up its new position at right angles to the mast, in order that the pilot may be able to impress his wish on the rotor without interference from the bar; for the parallelogram of linkage between bar and rotor will hold the rotor in a fixed plane (due to feathering action). If friction or other form of damping is introduced at the bar pivot point, the bar can be made to "follow" the mast at any desired speed. The model builder can hold the model over his head and tip the fuselage quickly and have a companion observe the bar following the mast. Provision should be made for introducing a slight amount of bar friction except in very small hand launched models.

Now that stability has been discussed as the most important factor in model helicopter flight, the next problem is torque. See Newton's Laws for the physics on this. The main rotor in a single rotor ship develops a torque force opposite in direction from its rotation. Therefore, a means must be developed to prevent the rotation of the fuselage. An antitorque prop is used producing a compensating thrust for main rotor torque. This little propeller should rotate on its axis so that side thrust is near the plane of rotation of the main rotor, otherwise the side force will produce a couple, tending to turn the fuselage on its longitudinal axis, which results in cockeyed flight. There are contra-rotating systems, coaxial, tandem, and intermeshing configurations that compensate the torque of one rotor system against that of the other. These systems are intriguing, but the complications of power transmission to, and control of, these rotor systems is so great that it presents too many subsidiary problems to the model builder before he gets into the air.

The next major problem for the model builder is: power and its transmission to the rotor. Mr. Young's early attempts at powered flight made use of an outboard motor. A year was consumed in modifying the engine so it would start and run properly at a constant rpm in conjunction with the required gearing. To make a suitable powerplant for a model helicopter employing the standard model engine of A, B or C class, it is necessary to devise a clutch, free wheeling device, and flywheel to accommodate the terrific acceleration at starting, then reduction gearing to bring rotor speed down to about 1200 rpm.

Soon, it is expected that a power package for A and B class engines will be put on the market to assist model builders who do not have a fully equipped machine shop. This kit is the result of two years work and will certainly be worth waiting for. Electric motors are an ideal source of power in that their output is constant with smooth acceleration, re-

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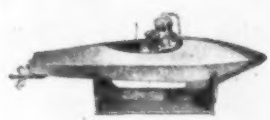

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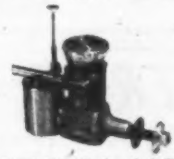

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ducing vibration and gear box wear.

Underlying all design and building problems for the model builder is the basic problem of flying weight. Unfortunately helicopters, model or full scale, are even more critical in this respect than fixed wing aircraft. Flying weight of the R.O.G. rubber power model illustrated is 2 ounces. The rubber motor weighed .4 ounce, giving only 30 seconds flight maximum. The model was stable and made over 56 flights. It is still in flying status, though very weighty due to age and many paint jobs. Flying weight for gas model helicopters is in the range of 20 to 30 lbs. per hp as compared to 14 or 15 lbs. per hp for full scale. The permissible disc loading in models is lower because model rotor blades are far lighter in proportion to total gross of the aircraft than in full scale. The determining factors governing rotor diameter in full scale are weight of material of blades for required structural qualities, control problems, and forward speed.

It should be borne in mind that blade weight goes up as the cube of the rotor diameter. Generally speaking, gas powered model helicopters are approximately 80% as efficient as full scale. Rubber power ships are only 30% as efficient as full scale. Rubber is an attractive power, however, because it provides gently decreasing torque, allowing the model to sink gradually under its own power without crack up on landing; this is also an advantage of electric power. Gas powered units require a free wheeling and automatic pitch change device to allow the model to autorotate when the engine stops, otherwise the model will be in a free fall from several hundred feet and cause quite a splash on landing.

While discussing rotors, it is well to advise model builders to keep their rotor blade sections very thin; this is particularly true of rubber powered ships.

From careful study of photos of successfully flown full scale helicopters, the modeler can determine a good configuration and control arrangement. The major problems are: a sweet running rotor with some degree of reliability, proper CG location, and adequate torque correction.

Many hours of pleasant and instructive flying may be put in flying model helicopters. Helicopters provide a new dimension of flight and, as is the case with full scale, the models can be flown in small areas. You don't need all outdoors to fly model helicopters (but it helps!).

### Miniature Ercoupe

*(Continued from page 9)*

used, seal the wires together with small amounts of solder (acid core). Incidentally, a good tip is first to bend your landing gear parts from soft wire to make sure you have the proper shape before proceeding with the steel wire.

Any Class A and possibly some of the smaller B motors may be used. Mounting depends on your preference and the limitations of your particular motor. The author finds these small motors start and run equally well in an inverted position and certainly the more realistic cowling is desirable.

If you use a diesel motor it will be unnecessary to remove the two 1/8" x 1/4" main spars. Otherwise, these spars should at least be removed between bulkheads C and G, as they have served their purpose of holding the fuselage straight until the stringers are in position.

Before covering the fuselage it might be an advantage to complete the tail sur-

faces. These are described in detail on the drawing and are of simple yet sturdy construction. Use aluminum sheet or soft wire for rudder hinges and tracing paper for elevator hinging. The elevator control horn is aluminum sheet or tin.

Engine ignition parts are installed now and are located approximately as shown on the drawing; they are then shifted fore and aft until balance is correct. The model should balance at a point 1/3 of the wing chord (width) back from the wing leading edge. When this is possible you have determined the proper locations for the ignition units and they may be permanently secured.

Installation of the elevator control bellcrank must be rugged; it is therefore attached to a 1/8" hardwood or plywood cross member. The control rod is steel wire held in position by small washers and solder. This entire assembly should work friction-free in order to insure efficient control of the model while in flight.

Use a flexible grade of 1/32" balsa sheet to cover the fuselage and glue only where necessary. Sand lightly and, if possible to obtain, fill in any low spots or cracks with Valentine spot putty. Tissue, silk or Silkspan is then covered over all wood surfaces except the cowling. Dope is applied only to the edges of each section covered by one piece of tissue, and the entire fuselage is sprayed with water to tighten the paper. Tissue covering over all concave surfaces (fillets, etc.) should be well secured with dope to prevent stretching and forming a flat spot.

The cowling for this model may be built up as shown on the drawing, or cut from solid balsa block. If the built up structure is used you will find it more satisfactory to cover the cowl with double thickness 1/32" sheet than to attempt applying tissue to the compound curves.

Finish for the cowling, rudders, elevators and other wood surfaces should include application of some light weight wood filler to cover the balsa grain. Valentine Lacquer Wood Sealer is excellent for this purpose and it will cover well with just one or two coats.

Structure for the outer wing panels is not standard in that diagonal ribs are used as in the full size *Ercoupe*. You will find them simple to plot and very useful for other models where lightness and strength are required. Wing mounting pins are 3/32" dia. steel wire and they must be located to give flush top and bottom surfaces, when the outer panels are matched with the centersection. Cover the leading edges of the panels with 1/32" sheet and the entire wings with tissue or silk. Again apply dope only to the outer edges of the section to be covered. Spray with water and let dry before doping with silver.

Trimming and lettering is done after the silver dope is applied. The silver should require two to four coats with light sanding between applications. Use Scotch masking or cellulose tape to guide the stripes and letters.

Control line flying is standard procedure and 35 to 50 foot lines are recommended. Note the rudders trim individually and outward only.

Happy landings, and let's see some of these *Ercoupes* entered in the scale and stunt events of the coming contest season.

PHOTO CREDITS

| Page | | |
|---|---|---|
| 2 | Upper | Glenn L. Martin |
| 2 | Lower | British Combine |
| 17 | All | Martin and Kelman |
| 21 | All | Henle Spokane Photo |

## Albatros D-XI

*(Continued from page 21)*

carved and sanded so as to streamline the cowl sides (see top view). Now rub several coats of wood filler into the cowl and its fairing. Sand between each coat of filler and you'll have a neat job.

Cover between formers 3 and 4 with bond paper and cut out the cockpit with a sharp pointed blade. The top of the fuselage may now be covered. The author held down the weight by using the lightest weight tissue available. White tissue was used and the fuselage was left undoped except for the top and bottom where the tissue was first water-sprayed and then clear doped.

Add the tail skid assembly; the fin is cut from 1/16" sheet, sanded, and coated thoroughly with filler. The skid proper is a piece of bamboo which has been sanded round, then bent over a candle flame to correct shape. Cement the skid to the small fin and the entire assembly to the bottom of the fuselage.

The only colored dope used was light blue on the top of the fuselage forward of the back of the cockpit; the same blue is used on the entire outside of the cowl and for the cowl fairing. The inside of the cowl is doped a dull black including the dummy cylinders.

Detail fans may want to fabricate a rotary engine which actually revolves with the propeller; to do so, though, would result in considerable gyroscopic effect—too much for good flights, so this is not recommended.

EMPENNAGE—The tail surfaces are built up in the usual manner directly over the plans. It is well to use wax paper over the plans to prevent the cement from sticking to them; unprotected plans and cement can make a messy model. Since only half the elevators are shown, you must trace that half on thin paper; invert your tracing and redraw. Put the two half-plans together and build over them so that the elevators are in one piece. 1/16" flat stock of the widths shown is used throughout the rudder and elevators. When empennage is dry, remove from work board, sand and round all edges and cover with white tissue. Spray lightly, weight the piece to prevent warping while it dries, then give each side of each piece a light coat of clear dope.

Warping of such thin assemblies can easily be prevented if the dope is quickly brushed on a small portion of one side, then on the corresponding area of the reverse side immediately afterward; both sides then dry at the same time, thereby putting the same amount of strain on the framework.

When the tail surfaces are finished, the elevators are cemented in place between the fuselage halves in the slit provided for this purpose. Cement the rudder in place along the center stringer. Carefully line up each part exactly as indicated on the plan. No rudder off-set was used, nor is it necessary. Note that there are no tail brace wires to bother with.

WINGS—Here is where time is saved. The top wing is without dihedral, so cut it in one piece from a sheet of the best 1/32" sheet balsa you can obtain. Again apply the fine sandpaper and the wood filler to each side simultaneously as you did on each side of the fuselage. The camber (see side view) is warped into the wing when you apply the wood filler. Camber as herewith used will provide plenty of lift. Get that camber into the

wing—it is all important! Small irregularities in the airfoil can be rectified later by holding over a steaming teakettle. The bottom wings are made in halves, following the same procedure in their formation as with the top wing.

WING STRUTS—Make two cabane struts A from 1/16" thick hard balsa. These must be made accurately for they determine the wing incidence angle which is *very* important. Two cabane struts B are needed; cut from 1/16" stock also. (These latter B struts are actually part of the aileron control mechanism on the real plane, but because they are handled like struts on the model we'll call them struts.) The wing support struts, four in number, are cut to shape from 1/16" sheet. Make two interplane struts from hard 1/16" balsa, too.

Sand all these struts to streamline shape and rub in several coats of wood filler.

The landing gear struts are formed thus: prepare a strip of firm bamboo, 1/8" square, and bend over a candle flame to the shape and length shown on extended diagram near the front view. After bending over the flame, allow to cool; then carefully split with a single-edge razor blade. Result: you will have the two needed struts and they will be exactly alike. Fill in with a small piece of 1/16" sheet hardwood as indicated and drill a small hole to take the axle.

ASSEMBLY—Cut small holes through the tissue to receive the cabane struts, then mount these struts to form an inverted V as seen on the front view. The cabane struts are cemented directly on top edge of the fuselage sides. Use plenty of cement and fair them in neatly. At this time also cement the two small struts B in a vertical position as shown.

The lower wings are cemented in place, one at a time, to the side of the fuselage. If your work has been accurate, and if you cement them exactly as shown on the plans, they will have about two or three degrees of positive incidence. Here again use plenty of cement; then block the fuselage into position and place small scraps of balsa beneath the tips to allow for 1/4" dihedral angle on the leading edge of the lower wings just one inch inboard from the tips.

When the lower wings are dry, run a little more cement along the line where they attach to the fuselage sides. Work this cement with a sharp pointed stick into a neat fillet which will add both to appearance and strength.

The lower wing support struts are now cemented in place, two to each side, and staggered as indicated in the side view.

Now is the time to carve two miniature Spandau machine guns from odd scraps. Mount one high and to the outside of the right cabane strut as indicated on the front view. The other gun is mounted directly along the line formed by the center stringer. Both guns are directly in front of the cockpit. Note that the center gun is mounted with the barrel flush against the fuselage top while the right hand gun is mounted high utilizing the entire breech of the gun. A little ball and ring sight mounted on the center gun will add a rare bit of detail for a flying scale job.

Now dope all the struts and the two guns with dark gray dope before the top wing is mounted. You may also dope the tail skid.

The top wing is mounted, carefully straightened and allowed to dry. Then the interplane struts are cemented in place and doped dark gray.

Lay the model on its back and cement

the landing gear struts in place. Lots of cement (use discretion) neatly faired around the joint and you'll have an unusually sturdy gear. Dope the L.G. struts dark gray also. For the axle the author used a piece of .020" steel wire. "Store wheels" of the correct size were not to be had, so wheels were built-up of laminated sheets of balsa and cemented directly to the axle after same had been slipped in place. Dope axle dark gray.

The model in the photos is shown with a scale propeller and spinner. For flying however carve a prop from very hard balsa, from a block of the dimensions given on the diagram just below the front view. Equip flying prop with a shaft of .020" wire, bearings, and a nose plug and 2 or 3 loops of 1/8" flat rubber. The rear motor hook consists of a short length of dowel through the fuselage sides.

FLYING—If built carefully and according to plans and instructions, your Albatros D.XI will weigh not more than one ounce. Test by gliding into tall grass. Add weight to either nose or tail by small bits of molding clay. Most likely a small bit of weight will be needed on the nose; if so, place the clay inside the front of the cowl. When your D.XI has been adjusted for a nice flat glide, put in about 50 turns and launch from shoulder height.

When satisfactory power glides are achieved, wind to capacity and try several R.O.G. flights. You will be amazed at the climb of this little job. If longer flights are desired (and when aren't they), lubricate the rubber strands with a mixture of green soap and glycerine.

The D.XI makes a good mantel piece when decorated with the straight-sided German crosses of 1918; decals are best and easy to apply. One last optional detail; the little step beneath the left side of the cockpit may be added if desired; if so, make from scraps and dope dark gray.

These instructions are longer than usual; they are intended to aid the beginner in scale modelling, as this ship is an excellent one to try the hand on. Good Luck!

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## Flash News

(*Continued from page 2*)

that this nation has only *one* of most of the jet bombers and fighters flown during the day, with quantity production months and months away. The array of new types reads like a list from the confidential files of Army and Navy: North American XB-45 and XFJ-1; Consolidated Vultee XB-46, Vought XF6U-1, Republic XP-84, Lockheed P-80B, Douglas XB-42 and XB-43, D-558 and AD-1; Stinson L-13, Northrop XB-35 and N9M and the Bell XS-1. All were flown during the day including highspeed passes over the field in a thunderous recognition of jet power and its future possibilities. Outstanding for speed and maneuverability were the 2 North American aircraft, both clearly the best in their class. A surprise was the Douglas XB-43 (*Mixmaster* powered by two TG-180 jet units), the most awkward airplane on the field but one of the fastest and smoothest in the air. A disappointment was the beautiful Convair XB-46 which, for all its shapely, pencil-thin lines, appears sluggish and heavy. Most exciting was the Douglas D-558, easily the fastest airplane in the world today, when as and if the Douglas-Navy-NACA team decide to "let it out."

CHANGES IN the Martin 2-0-2 have been completed on a prototype airplane and CAA tests have been resumed, following its disapproval in its original form and resulting in a costly delay to Glenn L. Martin that required his negotiation of an RFC loan to carry him over. More wing dihedral for lateral stability and a large dorsal fin for greater directional stability have been provided. Following CAA tests, production on a still-mounting backlog of orders will be resumed on this new "DC-3" of the airlines.

FUTURE OF THE North American *Navion* is now assured following its purchase by Ryan Aeronautical in San Diego. Production will be resumed following a considerable delay in transfer of tooling and completed parts to Ryan, the period being used as a "breathing spell" to allow *Navion* orders to crystallize and to fill the pipe-line with spare parts. Look for Ryan to make changes in the airplane in the next few months, bringing his long experience in lightplane design to bear on the problem.

LATEST MODEL of the famed Vought *Corsair* is the F4U-5, now in production at Stratford, Conn., plant. Although the only external difference is a pair of air intakes mounted along the engine cowling, the cockpit has been completely redesigned to provide ease, comfort and safety of operation. The canopy, trim tabs and auxiliary hydraulic pump are all now power-operated. A special feature is the brake pedal design, which may now be swung down flat to provide a leg rest for long flights! About 200 F4U-5's are to be built, production continuing until July 1, 1948.

FIRST NEW postwar engine to be announced is the Pratt & Whitney R-2180-E, developing 1650 hp at 2800 rpm from takeoff to 3000 ft. The new engine is designed especially for twin-engine aircraft carrying up to 30 passengers at speeds of up to 250 mph. The R-2180 is now in production and will be accompanied shortly by Rolls-Royce *Nene* engines on the assembly line.

FOR THE FIRST time in history the CAA Board has issued a certificate authorizing transportation of property and mail by helicopter. Los Angeles Airways, Inc. will fly 3 routes totalling 200 miles radiating out from Los Angeles to various post offices in the local area. Between 4½ to 19½ hrs. will be saved by delivering mail direct to local post offices by helicopter. Other cities are planning to apply for similar services soon.

NEW RYAN XFR-4 is equipped with special flush inlets to its Westinghouse 24-C turbojet engine located in the tail. The new *Fireball* design is not a production type but is being used as a flying test bed for the more powerful engine and its radical new internal air system.

WHAT MAY INDICATE the end of the


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"sleeper plane," which achieved such fame during the 'thirties, was voted recently by United Airlines in its decision not to use the new Douglas DC-6 as a sleeper. Reason: there won't be time enough to sleep! Studies showed that the 9 hrs. 55 min. transcontinental flight time of the DC-6's in scheduled operations would permit only 7 hrs. for sleeping, allowing for dressing, meals, etc. In addition, the 52-passenger capacity is cut to 26 as a sleeper, requiring sleeper passengers to pay an extra fare of about $130, which would more than double the cost of transcontinental air travel.

FIRST FLIGHT of the Martin XB-48 proved successful, the giant craft taking off from the Baltimore plant and flying south to Naval Air Station Patuxent in lower Maryland. Check flights there will precede an expected flight to Muroc Army Air Base where the acceptance test flight program will take place. Although the East-to-West route involves headwinds, look for the Martin XB-48 to ring up some new low times on the trip westward. It is powered by six TG-180 turbojet engines, a total of 24,000 lbs. of thrust, most powerful airplane ever built!

NEW FAIRCHILD personal aircraft is an all-metal, low-wing tricycle landing gear design carrying four persons.

PRESIDENT TRUMAN'S new XC-118 was recently revealed, following extensive "hush-hush" publicity concerning it. A super Douglas DC-6 with all the trimmings, the plane is named the "Independence," after his home town or the spirit of this country, take your choice. A tour of the plane revealed it by far the most luxurious airgoing yacht ever built. Built-in compartments, smart color scheme and all the safety devices ever put in an airplane are included. Col. Henry Myers, "Sacred Cow" pilot, has been at the Douglas plant for several weeks and the plane should be ready for delivery by early fall.

NORTHROP XB-35 *Flying Wing* powerplant system is being thoroughly reworked at Muroc Army Air Base. Continual difficulty with the propeller pitch changing mechanism of the Hamilton Standard counter-rotating designs has resulted in substitution of Curtiss Wright three-bladed single-rotation designs, requiring extensive reworking of the Pratt & Whitney R-4360 drive shaft and gear boxes, propeller shaft housings, etc. Jet propelled XB-49 is scheduled to fly this year.

AUSTRALIAN AIRCRAFT industry is in quantity production on Rolls-Royce *Nene* turbojet engines, DeHavilland *Vampire* jet fighters, Avro *Lincoln* bombers and two versions of the Avro *Tudor* transport plane. The aircraft industry is practically nationalized and all airmail in Australia will shortly be carried by the government following the lapse of existing private contracts.

MR. AVERAGE Airline Pilot is 32 yrs. old, stands 5 ft. 10 in. tall, weighs 165 lbs. and has logged 4,859 hrs. states CAA.

RUMORS ARE FLYING that McDonnell is nearing success with a single-seat, jet-propelled helicopter.

WORK ON Wright Aeronautical Corp.'s turboprop engine is progressing according to schedule with a number of engines moving along the assembly line. Although details of the engine have not been revealed, Wright states its weight will make it impractical for anything but large bomber installations. First flight tests of the new engine will be in nose of a Boeing B-17 purchased and modified by the company for the purpose. The four main engines will be used, however, for takeoff.

WHAT MAY PROVE to be the first jet-propelled airliner is an Avro design being developed in Canada. The craft will be powered by two jet engines and will seat 30 passengers. If it proves successful it will go into service on Trans-Canada airlines, according to Toronto reports.

JOHN K. NORTHROP, in his recent paper before the Royal Aeronautical Society in London, told the following interesting account of an early flight with an XP-79 at 10,000 ft. when the pilot inadvertently released the escape hatch and partially fell out of the prone position enclosure: "The

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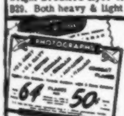


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instinctive grasp on the controls resulted in an indescribable wing-over and when things calmed down the pilot found himself in a steady glide upside-down. Minor movement of the controls seem to produce little effect and the much-shaken individual crawled out of the airplane. He sat on the leading edge of the center section while he checked his parachute harness and slid off in a parachute descent. The airplane, undisturbed by the change in c.g., continued its circling flight and finally landed upside-down a short distance from the takeoff point. It was damaged—but not beyond repair."

## Newsletter

*(Continued from page 6)*

direct your attention to an article which appeared in the "Northern California Model News," an excellent publication produced on the West Coast. The item:

JIM NORVELL KILLED BY HIGH TENSION LINE

*Santa Cruz*—Jim Norvell, 19 year old Santa Cruz model airplane flyer, was killed here on Nov. 6, when the wires on which he was flying a model plane came in contact with a high tension power line.

At the time the item was published we figured it was a 1,000,000-to-1 possibility and didn't think it was necessary to comment on it. But we were wrong—very wrong. It recently has been brought to our attention that a member of the "Cowtown Sahibs" club of Ft. Worth, Texas was flying his control line ship when the lines came in contact with high tension wires.

This fellow was more "lucky" than Jim Norvell. He was severely burned on the hands and feet and hospitalized, but was expected to recover without serious effect. We know just what this sort of thing can do to you. While overseas with the Army Airways Communications System your reporter was knocked out by 10,000 volts while making hasty, emergency repairs to a highly important AAF ground station. We were "lucky," too—but at least with us it was serious and in the line of duty and not while flying a model airplane for fun.

It is our suggestion that the foregoing four paragraphs be clipped and posted on your club's bulletin board. Even if you are not now flying near high tension lines, individual members may be some day soon.

EDITOR H. G. PUCKETT of N.C.M. News commented on the confused control line rules out Pacific Coast way. He says: "When I was attending an aeronautical school a few years back, I was confronted with a question that was really a question. I was after a CAA Ground Instructors License to teach Army Air Corps men when the particular incident came up. I asked my instructor which I was supposed to believe was correct and he answered for me, 'If you're studying for a CAA exam, CAA is right, and if you're studying for an AAF exam, the AAF's right.'

"I wanted to know more, so asked him how come the two authoritative authors couldn't agree before publication. His answer was: 'If you don't agree with either one, then there will be another manual on the market.' The connection to model airplane flying is now in the rule situation. There are now 4 major sets of U-Control Precision Stunt Rules: Academy of Model Aeronautics (AMA), Aero Modelers of Northern California (AMA-NC), Southern California Model Congress (SCMC), and the latest California Association of Model Clubs (CAMC).

Mr. Puckett goes on to discuss how the East-West Control Line Challenge Meet in St. Louis could have been the means of developing a compromise set of rules which would satisfy all. Well, that's going to be a tough job, believe us. We've spent over 10 years trying to get designers, builders, flyers, contest sponsors, meet directors, timers, recorders, processors, members of the model industry, and countless thousands of "Sunday" modelers to agree on

*See Special Offer on Page 63*

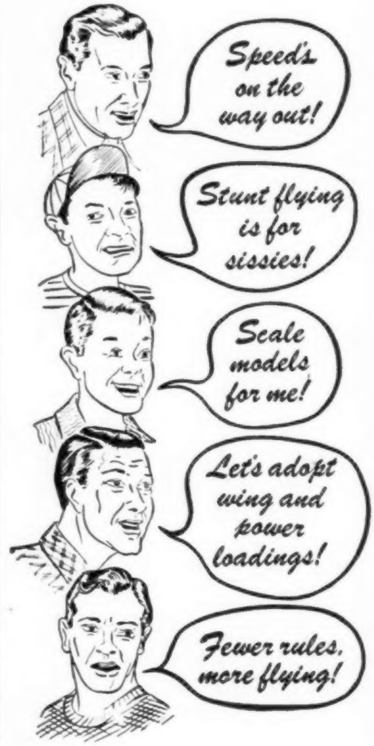




rules and we feel you'll never be able to satisfy everybody.

However, in the hopes that Mr. Puckett can do something from his end in coordinating, simplifying and standardizing regulations we offer absolutely free the following requirements in the order of their importance:

1. *Safety*—the spectator, flyer and future of the sport must be protected and assured.
2. *Fair*—everybody must get an equal chance.
3. *Simple*—must be easy to understand, follow and enforce.
4. *Promote progress*—rules should encourage new ideas, new designs, improvements, innovations, gadgets, good flying.
5. *Brief*—keep 'em as short as humanly possible, yet they must avoid ambiguity.




Mr. Puckett was quite right in saying that quite a controversy is raging currently over the stunt (or precision, if you will) regulations governing line flying. Reason for this is understandable: control line flying is sweeping the nation, and stunt, precision and scale model flying on control lines is rapidly pushing straight speed flying into the background.

A recent copy of the trade paper, "Model Airplane Newsletter," reported results of a survey of kit sales by retail establishments of the country. It was found that of all gas kits sold, 62½% were control line models, 37½% free flight type. The percentage in favor of control line shot up in the large metropolitan areas where free flighters have lost flying fields as housing and business projects took over their former modelports. Only in the midwest and less populated districts did free flight kit sales anywhere near equal U-control kits sold by hobby shops.

Trouble with straight speed flying is that it is mighty expensive for the average hobbyist. You need a costly engine; then you must have it "souped" up; naturally you need an electric starter, and so on. In many ways it resembles race cars—interesting at first, but monotonous. Now don't get us wrong—we're not talking against speed flying. It's just that we see control line stunt and scale events as the more

appealing for the average pocketbook and fan.

This was exemplified last Memorial Day when Levy Bros. Store, Elizabeth, N.J. put on its annual control line meet. Of the thousands of spectators, the majority were most interested in the stunt events once they'd seen the speed jobs perform for five minutes. As a result, the sponsors have indicated that next year's competition will probably be for precision and scale flying only. Speed jobs will be flown, yes —but only as "special demonstrations."

At that meet, we were inveigled into judging the stunt flying and for six solid hours stood under a blistering sun watching more than 50 of the East's best stunt pilots put their jobs through all manner of intricate maneuvers. To us it was a great way to spend an afternoon. We'd like to watch precision flying every afternoon in the week!

(To our other old friends we hasten to say that, as far as pure science is concerned, indoor "mike" jobs are dearest to our hearts; we feel you can learn more about aerodynamics building and flying "indoor" models for one week than you get from any other type in a year!)

But back to stunt flying: The A.M.A. stunt rules still looked good to us after 6 hours of following them at Elizabeth. Although your reporter was not a member of Jim Walker's A.M.A. stunt rules committee which drew up the original rules, we were directing Academy activities from Washington, D.C., at the time and know how very hard committee members worked and how careful they were not to favor one section of the country over another, one type of equipment over another, or one type of model over another.

Our criticism on the rules is that they should be presented in illustrated form so judges can better decide how well a maneuver is done, and fewer points should be given for spot landings since with one-speed motor operation it is pure luck where the motor cuts. But the small amount of carping that has been done by some who claim that chairman Walker favored rules which needed his equipment is pure bunk. Jim has always been a modeler first and a businessman second. We feel precision flying would never have made the gains it did had it not been for his personal appearance tours, numerous letters replying to queries put to him, and his unbounded belief in the future of control line flying at a time when most modelers and leaders were laughing at him for daring to suggest it might be fun to fly models on the end of two controlling wires, with motor running continuously instead of just for 20 seconds.

That U-Control and G-Line flying is here to stay is shown by the announcement that the N.Y.C. Department of Parks, after barring model plane flying from the recreation-sport areas in the metropolitan area for many years, has set up a control line flying field with 6 circles, barricades and police protection on the site of the old World's Fair parking site. Free flying of any type is still "out" as far as NYC is concerned (there just ain't the room, fellows), but the controliners are welcome.

Before signing off, we want to jump back to the subject of West Coast control line precision rules. Let the AMA-NC, the SCMC and the CAMC get together, iron out differences, and come up with a satisfactory set of precision regulations for judging stunt events. Then give these to the A.M.A. with a request for serious consideration. West Coasters will find the Academy wide open to suggestions.

We all admit the West has done mighty well in the field of control line flight and competitions. Multiplying all California assertions and claims by 50% to reduce the natural effect of West Coast-ism (we lived in the Golden Gate state for 7 years, as well as in Texas, and know when to apply the salt!), we still find the California crowd leading in U-control "know-how."

So get together, West Coast "Big 3"; then present your results to the A.M.A. Let's have more action, more compromise and less cussing.

# GMCO NOTES

**VOLUME 2 NO. 10** — **SEPT. 1947**

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- 3/32 x 3/32 6 ... 5c
- 3/32 x 3/16 ... 1c
- 3/32 x 1/4 3 ... 5c
- 3/32 x 3/8 ... 2c
- 3/32x1/2 ... 2 1/2c
- 1/8 x 1/8 6 ... 5c
- 1/8 x 3/16 ... 1c
- 1/8 x 1/4 3 ... 5c
- 1/8 x 3/8 3 ... 5c
- 1/8 x 1/2 .. 2 1/2c
- 1/8 x 3/4 .. 3 1/2c
- 1/8 x 1 ... 6c
- 3/16x3/16 ... 2c
- 3/16 x 1/4 ... 2c
- 3/16 x 3/8 2 1/2c
- 3/16 x 1/2 ... 3c
- 3/16 x 3/4 ... 5c
- 3/16 x 1 ... 7c
- 1/4 x 1/4 .. 2 1/2c
- 1/4 x 3/8 ... 4c
- 1/4 x 1/2 ... 5c
- 1/4 x 3/4 ... 7c
- 1/4 x 1 ... 8c
- 5/16 x 5/16 ... 5c
- 5/16 x 3/8 ... 6c
- 5/16 x 1/2 ... 8c
- 5/16 x 5/8 ... 9c
- 5/16 x 1 ... 12c
- 3/8 x 3/8 ... 9c
- 3/8 x 1/2 ... 10c
- 3/8 x 3/4 ... 12c
- 1/2 x 1/2 ... 10c
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- 1/32 x 3 ... 10c
- 1/16 x 3 ... 11c
- 3/32 x 3 ... 13c
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- 3/16 x 3 ... 17c
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## Model Airplane Course for Beginners

(*Continued from page 31*)

After the balsa has dried—held in the above manner—the sheet will retain its tube-like form. The drying process can be speeded up by use of an infra-red lamp or a controllable oven.

When the sheet has dried, remove the gauze and cement together the seam or balsa edges. If necessary, wrap the 1/8" rubber strip with light tension around the tube (cement will not stick to the rubber), to hold the seam closed while cement hardens. After the glue is dry, unwind the rubber and slide the balsa tube off the wax paper covered dowel. A light sanding of the seam may be required if an excessive amount of cement has been used.

Application of a few coats of clear dope to the assembly will strengthen the tube considerably. The dope is applied with a soft brush.

Two key blocks are now made, as shown in plans, and cemented inside each end of the tube.

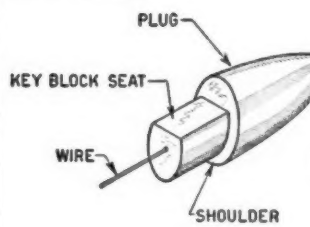



FIG. 19

The nose and tail plugs are then constructed. Fig. 19 illustrates the "inside" end of the plugs. Note that a "seat" or "flat" is cut into the aft portion in order to allow the plugs to slide past the key blocks cemented inside the tube. When the key block rests atop the seat, the plug is held in place and prevented from turning against the torsion in the rubber motor.

**Tail Surfaces.** As indicated in the drawings, the tail surfaces are constructed of 1/16" sq. strips and some 1/16" sheet. The rudder base and center rib of the stabilizer are of sheet. To construct these sections, cut the balsa pieces to correct length and form, pin full size plans on board with a protective covering of wax paper over them, and assemble the strips over the drawing to form the tail.

The balsa is held together by model airplane cement. To prevent a sloppy job, do not apply excessive amounts of glue to the joints. Pins may be used to hold the frames together on the plans while the cement is hardening. However, the pins are placed next to the strips and *not* through them.

After the tail frames are completed, cover one surface of each with tissue. Brush clear dope on the surface of the frame being covered. Before the dope has dried, place tissue on frame, pulling edges evenly to form as smooth a covering as possible. After the dope has dried and the tissue is securely attached to the frame, trim excess with a razor blade and sand lightly with super-fine sandpaper (edges only).

**Wing.** The wing is assembled in two panels each consisting of ribs, leading and trailing edge. The ribs are made of 1/16" sheet balsa as shown in the plans. A notch is cut into the front end of the ribs to receive the leading edge. The leading edge is of 1/16" sq. balsa with one corner

sanded round to form the wing rib nose. The trailing edge is of 1/16" x 1/8" strip sanded to a thin edge at the rear. The flat full 1/16" end is cemented to the aft end of the ribs.

The procedure followed in constructing the tail also applies to the wing construction. Fig. 20 illustrates the setup. After the various parts of each panel have been completed, assemble as shown. It is advisable to use a heavier rib at the wing tip (rib no. 7) in order to resist the pull of the paper when it is tightened. Two ribs of normal thickness will do the job.

When the assembly is dry, apply tissue covering to the wing over the cambered (curved) upper surface. Dope is used again to fasten the covering to the frame. To complete our wing assembly, the pylon wing mount and saddle must now be made.

The mount is shaped as shown of two pieces of hard balsa. The pylon strut is made of 3" x 3/4" x 1/8" and must be beveled along the topside, as shown in front view, to permit the required tip rise (or dihedral) when the wing is assembled. In addition to this, the lower edge is sloped 3/32" fore and aft to set the wing incidence angle. After cutting and beveling the pylon, sandpaper the front and rear edges to form a streamlined section. The pylon is cemented to a saddle made of 4" x 9/16" x 1/4" balsa. The curved outer surface of the saddle may be cut and sanded with very little difficulty. The inner surface, which fits over the balsa tube, must be smooth and free of bumps. This may be cut first as a "V" channel with your knife, then, using the dowel as sanding block, finished with various grades of sandpaper. Cement the two wing mount parts together, and after the glue is dry, cement the wing panels to the pylon.

**Propeller.** The propeller is carved from a block of balsa 7" x 1-1/4" x 5/8". Procedure for its construction is identical to that described in Lesson 3.

**Wire Parts.** Method of forming the wire parts is also described in Lesson three. Note, however, that before the propeller shaft is attached to the prop it must be inserted through the aluminum tubing provided as bearing in the nose plug. A bead or two washers are also placed on the shaft before it is fixed to the prop.

**Assembly.** Assembly of the model at this point is an easy matter. Before doing so, however, we must further tighten the tissue covering of the wing and tail.

Using the artist's spray tube and a glass of water we are in business. Before operating, however, test your setup and skill over the kitchen sink. Place the long end in the water and blow on the short one. By controlling the vigor of your blowing, a light or heavy mist is sprayed in the direction aimed. When the proper technique for a fine spray has been mastered, aim the tube at the wing and tail and blow. Avoid an excessive amount of water reaching the surfaces or warpage will result. A small amount of moisture on the tissue, however, will tighten it up after drying.

Next step is to slip the stabilizer through the slot provided at the base of the rudder—cement it into place.

Attach the landing gear and tail skid to the motor tube—cement and wrap with thread as shown. The wing is held to the fuselage with rubber loops. The wheels are slipped onto the landing gear and prevented from dropping off by a drop of cement applied to each axle.

**Powerplant.** Motive power for our model

is furnished by the 1/8" flat brown rubber. Use a single loop for power in the early flights. Later as you become accustomed to the ship a second loop may be added. The loops measure about 14" long. Rubber lubricant described in a previous lesson may also be used to "soup-up" the rubber.

**Balance.** Balancing the model is accomplished same as our previous models. The craft should balance at approximately 1/3 aft of the wing leading edge. Approximate location of the wing for proper flight balance is shown in the plans. Because the wing is movable, balance should prove simple.

**Flying.** As in balancing, flying technique is similar to that developed through our previous lessons. In order that the builder may refresh his memory and check himself on the procedure involved, it is advisable to read over the flying instructions of Lesson 3.

With these instructions mastered and the model successfully completed, you are well on your way toward more advanced model projects and added pleasures.

Our next lesson, dealing with the construction of an outdoor fuselage model, will take you out of the novice class and set you right up there with the other fellows.

But before taking off, let's see what questions some of our fellow fledglings have on their minds.

* *

Richard Baker of Salt Lake City asks:

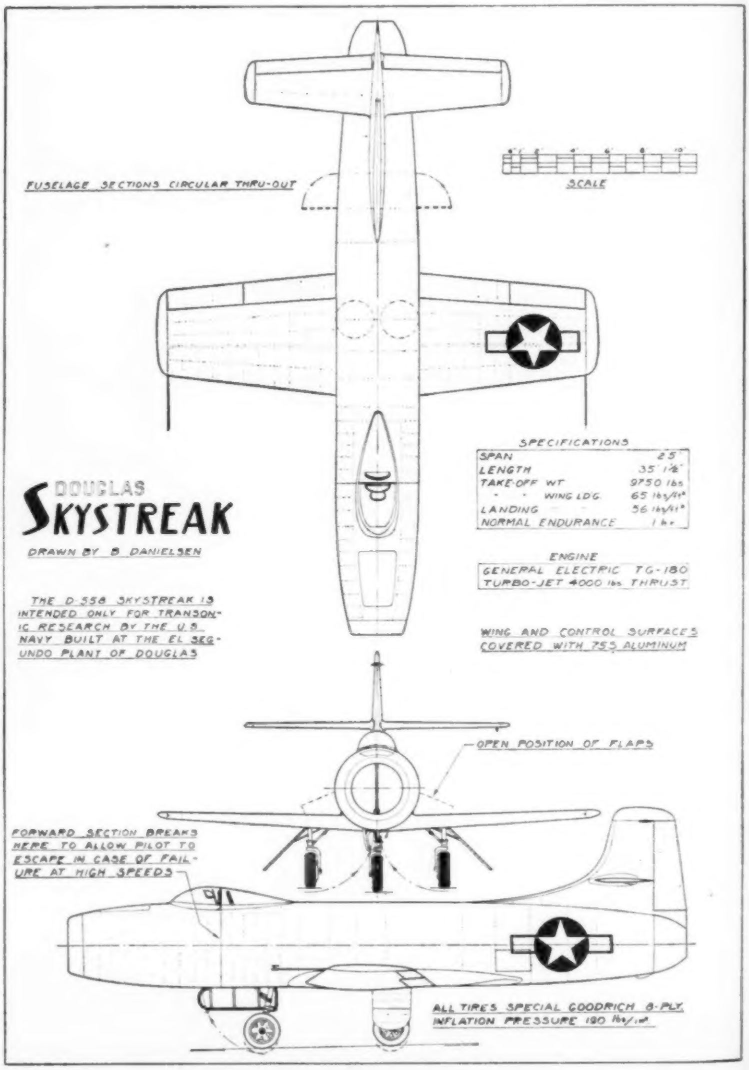
*QUESTION:* What is spiral stability?

*Answer:* It is the ability of a model to resist or recover from simultaneous displacement about its three axis—vertical, horizontal, and longitudinal. (See Question 1 of Lesson 1).

Joe Toomey of Seattle, Wash., asks:

*QUESTION:* What factor determines propeller blade areas for rubber powered models?

*Answer:* Blade areas are based upon percentage of wing areas and will vary from 5 to 15% of the wing area depending on degree of climb desired—high climbs require the greater areas.



## Air Ways

(*Continued from page 28*)

PICTURES WANTED.—We often receive letters from rubber or free flight gas enthusiasts complaining that we print more pictures of control line models in "Air Ways" than of all other types. The sad fact is that while we receive plenty of good control line pictures, and while we try to be impartial in our selections, the rubber fliers simply don't bother to send in their photos.

We have always wondered why the control line boys seem to take so much more pride in their models and outdo each other to send in fine photos. We have practically no photos of rubber models here now. We need some badly, and would also like to have pictures of free flight gas models and of any unusual types, such as helicopters, seaplanes, homemade motors and the like, so that we can present a balanced crossection of model aviation of these pages.

Picture No. 1 shows a 1/12 scale flying model of the German Focke-Wulf 189 built by Mike Garnett (of *Bristol and West Model Club*) who lives at 534, Southmead Road, Westbury on Trym, Bristol 9, England. This model was rubber powered with 3 oz. rubber in each nacelle to drive the 12" props. Wingspan was 60", and airframe weight less motors 10 oz. Construction was all balsa with bamboo paper covering. The model flew like a duration job with a really snappy climb followed by a long gentle glide, the average flight being about a minute. R.O.G. proved disappointing as there was a pronounced swing on takeoff. Arranged so it could be dismantled into small sections, the outerwing panels could be knocked off so that no damage was ever suffered in flight. Mike was awarded second place in a west of England exhibition held during the war.

John M. Klover, 601 N. Galloway St., Xenia, Ohio, sent in No. 2 of his experimental tailless glider which was built to the configuration of the Cornelius XFG-1 (M.A.N. April 1946).

No. 3, by Edward Maloney, 1215 Hillcrest, Pomona, Calif., shows his detailed model of the German W.W.I Gotha bomber which is complete with bombs and racks, pilot, guns and wiring.

Robert J. Villers, Kewaunee, Wis., sent in No. 4 of his *Wanderer* which he contends "lived a glorious life while it lasted." After a really good flight, this model crashed into a bike wheel, burying itself over half the length of the fuselage.

Harold D. Herr, 511 W. Chestnut St., Lancaster, Pa., contributed No. 5 of his second *Simplex 25* engine. This one is the same as the plans with the exception of an aluminum head which makes it run a little cooler. The first one is being used in a "PDQ" control line ship and it works fine. These engines weigh 7¾ oz., turn a 10" dia. 8" pitch prop at high speed, and are easy to start.

No. 6, by J. D. A. Sigmond, Verl. Schrans 102, Leeuwarden, Holland, weighs 550 grams, has a 36" wingspan, and is *Atom* powered (since 1938 and still going strong). Mr. Sigmond writes that this model, which was designed with the help of C. H. Grant's pre-war articles, has a nice steep climb and very flat glide. Sigmond is now a member of the *Leeuwarden Model Airplane Club*.

Affonso Arantes, 733 Alves Guimamaraes, S. Paulo, Brazil submitted No. 7 of his original *Super Duper* which has attained a top speed of 86 mph. It is powered by a Super Champion and has a

21" wingspan. This ship was constructed as an experimental job to test the design. A new one, with cowled engine, spinner and take-off dolly, is under construction and Affonso hopes it will reach a higher speed mark. He writes he would be pleased to correspond with American builders, clubs and associations. Most of the gas modelers in S. Paulo are members of a club called *Equipe do Parafuso* (The Spin Gang) and they are all anxious to swap ideas with interested modelers.

James Hobson, 429 Camino del Sur, Palm Springs, Calif. sent in No. 8 of his 30" control line Fokker D-7 which was powered with a Merlin *Super "B"* at the time the picture was taken. Finished on April 24, 1946 this model has had over 60 successful flights, 9 major crack-ups and 5 different engines. With the *Ohlsson* 60, it flew consistently at 50 mph. While in Germany, James picked up one of the Krat engines which he reports runs beautifully although it is heavier than American engines and has piston rings. He offers to send pictures and information about this engine to interested readers.

No. 9, sent in by Robert B. Johnston, 6011 La Jolla Blvd., La Jolla, Calif. shows his flying wing control line model which is powered with an Aero *Mighty Midget*, has 4' wingspan, 380 sq. in. wing area, and weighs 2 lbs. 6 oz. He writes he has had several satisfactory flights with this model and has experienced no difficulties with stability or control.

Leon Tefft, 5321 Newport Ave., Chicago 41, Ill. sent in No. 10 of his Grumman XF5F-1 *Skyrocket* which is powered by two Burgess M-5 engines. Plans were made from a small photograph. This model weighs 7¾ lbs. and has a 4'8" wingspread. Look for this ship at the Nationals!

No. 11 shows Hans "Swede" Wall and his original design powered with a K & B *Torpedo*. The model has 390 sq. in. area, weighs 39 oz., has a Goldberg G5 section, 8" chord, 60" span, and length of 41". Its best time is 16 mins. and average flight is 3 mins. The photograph was sent in by Bill Sweet, 6901 Eastern Ave., Bell Gardens, Calif. who is Corresponding Secretary of *The Thermal Thumbers Model Club of Los Angeles*. This is a free flight club of 35 members, organized last October. All members must be AMA members. Meetings are held the first and third Thursdays at the K & B Mfg. Co.'s factory, Bell Gardens, Calif.

Bill Featherstone, Selkirk, Ontario, Canada submitted No. 12 of his first gas model. It is powered by an *Ohlsson 23* and has 50" wingspan; color scheme is red and white. With wheels attached and large batteries, the model flies realistically and has a flat glide. With wheels removed and penlite cells, it is exceptionally fast with a very steep climb. Nice work for a first try!

## NEWS OF MODELERS

Warner Buchelt, 453 Whitall St., St. Paul, Minn. would like to correspond with a modeler (preferably free flight) of his own age (12).

Russell Grimes, 701 N. 12th St., Beatrice, Nebr., a 13 yr. old modeler who has been building since he was 6, wishes to correspond with other modelers and promises to answer all letters. He has a *Rocket* motor he would like to trade for an *Ohlsson 19* or *23*, an *Atom*, or an *Arden .099*. Russell bewails the fact that there are no contests closer than Omaha, which is 100 miles away. Beatrice also lacks a hobby shop and a model club. Perhaps some modelers in a more active

## CURTISS XF15-C

Here is another of the "combination planes"—which have prop in front and jet in the rear. It will be featured in the October issue of M.A.N., whose cover will carry one of Jo Kotula's illustrations of this experimental fighter. Don't miss the

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*On Sale Everywhere September 9th*

area can keep Russell posted on their activities.

Joseph J. Souhrada offers readers semi-finished $\frac{1}{4}'' = 1''$ scale models (P-51, P-84, F-7, F-8) or model supplies in exchange for "Flight" and the "Aeroplane" (British publications) containing data on the B.M.W. 801 radial engine and data on the 20 mm. Mauser and 20 mm. Oerlikon cannon. Modelers interested in making this trade can contact him at 40 New St., East Islip, L. I., N. Y.

Jimmy Hyland, Kirkstall, Via Horoit, Victoria, Australia wants to correspond with an American model builder of his own age (16) who is interested in free flight gas and rubber models, and who would like to trade kits and accessories.

Peter B. Wyatt, 53, Clapgate Lane, Ipswich, Suffolk, England desires to correspond with an American, about 16 years old, who is interested in gliders.

R. Franklin, 51 Barbury Drive, Moredon, Nr. Swindon, Wiltshire, England, a modeler of 10 years' experience, would like to correspond with an American modeler who would be interested in exchanging copies of MODEL AIRPLANE NEWS for the British "Aeromodeller."

Georges Sablier and his sister Marian wish to correspond with other young modelers to exchange information and literature on modeling. Their address is 76 rue Lauriston, Paris 16, France.

We printed a photograph submitted by P. Kelterborn, Gstaltenrainweg 17, Riehen bei Basel, Switzerland in "Air Ways" last issue. Mail sent to the above address has been returned; we shall appreciate having Mr. Kelterborn contact the editorial offices of M.A.N. so we can send him the issues due him for publication of his photograph in "Air Ways."

## CLUB NEWS

### California

The San Francisco Recreation Department reports results of their Hand Launched Class A Stick Contest on May 17 in their bulletin, *The Third Dimension:*

1. Carolyn Saumer 2. Larry Giordanengo 3. Bill Oppenlander.

• •

From June and Jack Dyer's *Aeroneer* comes the following results of the "Southern" East-West Eliminations held at Bellflower May 25:

*Speed*

Class A Jr.—1. Bud Jamison.
Class A Sr.—1. Troy Burris 2. Bill Deemer 3. Les McBrayer.
Class B Jr.—1. Robert Keech 2. Al Wadleigh 3. Ray Benskin.
Class B Sr.—1. Keith Storey 2. Wallick & Van Natta 3. Don Newberger.
Class C Jr.—1. Parker Hubert 2. Duane Varner.
Class C Sr.—1. Wallick & Van Natta 2. Bob Thomas 3. Allen & Kitchens.

*Precision*

Junior—1. Robert Keech 2. Jack Gilroy 3. Duane Varner.
Senior—1. Bud Jamison 2. Dave Slagle 3. Donald Fox.

*Scale*

1. Chet Peterson 2. Troy Burris 3. Cedric Galloway.

The Precision (for the East-West Finals at Alameda) Contest Eliminations were held June 8 as there was a dispute over the precision rules. The Speed Team was picked from the above.

Results of the San Diego East-West Eliminations are:

Precision—1. Jim Saftig and Del Liddle (tied).
Speed Class I—No qualifications.
Speed Class II—No qualifications.
Speed Class III—No qualifications.
Speed Class IV—1. Jim Saftig.
Speed Class V—1. Robert Frank 2. Leyton Webb.
Speed Class VI—1. G. McDonald 2. J. Saftig.

*East Bay Aeroneers Association* held a large free flight contest May 18 at Livermore. Results:

Class A—1. Hugues 2. Foote 3. Drobshoff.
Class B—1. Allington 2. Volponi 3. Niblett.
Class C—1. Liebee 2. Barber 3. Peel.

The Stockton Gas Model Free Flight Contest was held May 4 with the following results:

Class A—1. Floyd Reck 2. Roy Anderson 3. Jim Elliott.
Class B—1. R. Allington 2. J. Volponi 3. R. Bray.
Class C—1. B. Steese 2. M. Bertolucci 3. Ed Wooley.
Junior—1. David Allen.

*San Francisco Vultures* held a Hydro Contest on June 8 sponsored by San Francisco Exchange Club.

*Los Angeles Aero Modelers* held a Rubber and Glider Contest May 18 with the following results:

Cabin (fuselage)—1. Loran Salisbury 2. Allen Trainor 3. Marvin Forman.
Stick—1. Bud Hubbard 2. Ralph Conn 3. Allen Trainor.
Towline Glider—1. R. E. Smith 2. Robert F. O'Brien 3. Arlen Wetmore.
Hand Launched Glider—1. Yuji Hirose 2. E. Slobad 3. B. Dagand.

*Sacramento Skyoneers* Annual Free Flight Contest will be held October 5.

*Do Little Flyers* held an All Precision U-Control Contest July 4 at Petaluma, sponsored by the Lions Club.

Willis L. Nye, Public Relations Director for *Alameda Aero-Modelers*, sent in the following results of final eliminations for the East-West team held at Washington Park, Alameda on June 15. The Alameda Club was host, and the event was sponsored by the Junior Chamber of Commerce of Alameda.

Class I—1. Bud Jamieson, 49:18 mph.
Class II—1. Mal Anderson, 85:51 mph 2. Ed Kroll, 68:33 mph.
Class III—1. Troy Burris, 104:34 mph 2. Roy Gregson.
Class IV—1. Keith Conrad, 68:96 mph.
Class V—1. Keith Storey, 120:64 mph.
Class VI—1. Wayne Mathews, 123:28 mph 2. Bob Thomas, 123:28 mph.
Precision—1. Don Gullota, 235 points 2. Ed Landsberg, 201 points.

* *

Results of the Second Annual All-Western Open Model Aircraft Meet held on June 27-29 will be published when received.

* *

*Fresno Gas Model Airplane Club* lists in *The F.G.M.A.C. News* these results of their U-Control Contest on May 25:

Speed A-B—1. Joe Jackson 2. Bob Cassidy 3. Willard Edmunds.
Speed C—1. Gene Webster 2. Gene Webster 3. Ronnie Silva.
Precision—1. Ralph Allred 2. Leroy Bitter 3. Vester Warner.

### District of Columbia

Results of the Second Annual National Capital Model Air Show held at Hybla Valley Airport on July 20 will be published when received.

### Illinois

*Chicago U Liners* held their Fourth Annual Control Line Contest on May 29 with the following results:

Class I Speed—1. Miss Pinckney.
Class II Speed—1. Vermoch.
Class III Speed—1. Mabrey.
Class IV Speed—1. R. D. Huffington.
Stunt—1. Tefft 2. Flagler.
Tu Speed—1. Flagler 2. Drouillard 3. Gehrke.
Combat—1. Knabenhans 2. Peters.

* *

*Pretzel Gas Model Club* will hold their Fourth Annual U-Control Contest August 31 at Taylor Park, Route 75, Freeport.

* *

The Betts Model Shop of Aurora held their 3rd Annual Invitational Meet at The Illinois State Training School for Boys at St. Charles. The meet was sanctioned by AMA, and results were:

Class B Glider—1. Earl Wagner.
Class C Cabin Rubber—1. Bob Clemens.
U-Control Open, Class 2—1. Stan Bernard.
U-Control Jr., Class 3—1. Dave Mann.
U-Control Open, Class 5—1. Babe Mabrey.
U-Control Open, Class 6—1. E. Price 2. H. Kelly.
Class A free flight—1. W. Vanderbeek.
Open Class B free flight—1. Joe Samuels 2. Cliff Baker.
Open Class C free flight—1. W. Vanderbeek 2. Earl Wagner 3. Dutch Hess.

These fliers will represent the West at the East-West Meet in September. They were winners at Alameda on June 15. Left to right:
Front row: Roy Gregson, Troy Burris, Ed Kroll, Mal Anderson, Bud Jamieson.
Second row: Bob Thomas, Wayne Mathews, Wally Wallick, Van Van Atta, Keith Storey, Keith Konrad. Rear: Don Gullota, Ed Landsberg.

### Indiana

Results of the AMA sanctioned Mid-Western Model Plane Meet held in Indianapolis July 13 will be published when received. This meet was sponsored by The Indianapolis Star, Indiana Department of the American Legion, and Aviation Post, Indianapolis, of the Legion.

### Iowa

Results of the 9th Annual Tallcorn State Model Airplane Meet held in Marshalltown on July 4 and 5 will be published when received. This AMA sanctioned contest was the first to have a special event for the Herkimer $CO_2$ engine.

* *

Results of the 5th Annual Davenport Model Airplane Meet held at Cram Field June 28-29 will be published when received. This AMA sanctioned meet was sponsored by the *Davenport Model Airplane Club.*

### Kansas

*Plane Tips,* official publication of *Wichita Planesmen,* reports the results of their Wichita Model Airplane Championships, sponsored by the Wichita Junior Chamber of Commerce, as follows:

Control Line Class III Jr.—1. Mike Raymond.

Control Line Class I Open—1. Duane Stone.

Control Line Class II Open—1. Jerry Schumaker 2. Duane Stone.

Control Line Class III Open—1. Dean Zongker 2. Bob Schuelke.

Control Line Class V Open—1. Jerry Schumaker 2. Bob Hardesty 3. Frank Manley.

Control Line Class VI Open—1. Frank Manley 2. Dean Zongker 3. Roy Dunlap.

Free Flight Gas A & B Jr.—1. Nelson Gordon 2. Fred Probst Jr.

Free Flight H. L. Glider—1. Jerry James 2. Leon Edwards.

Free Flight Gas Class B Sr.—1. Arthur Asher 2. Kenneth Dunlap.

Free Flight Gas Class C Sr.—1. Richard Wallace 2. Jimmy Brown 3. Jack Brown.

Free Flight Rubber Senior—1. Jack Brown 2. Kenneth Dunlap 3. Joe Yeager.

Free Flight H. L. Glider Sr.—1. Richard Wallace.

Free Flight Gas Class A Open—1. Joe Yeager 2. Eugene Linn.

Free Flight Gas Class B Open—1. Eugene Linn 2. C. E. Bates.

Free Flight Gas Class C Open—1. Les De-Witt, Jr. 2. Eugene Linn.

Free Flight Rubber Open—1. Eugene Linn 2. Adolph Riedl.

H. L. Glider Open—1. Stan Chilton 2. John Wurts 3. Fred Nyberg.

T. L. Glider—1. Fred Nyberg 2. Kenneth Dunlap 3. C. W. Davis.

Meet Champion—1. Eugene Linn.

* *

Results of the 4th Annual Kiwanis-YMCA Central States Model Airplane Meet held in Wichita June 28-29 will be published when received.

### Louisiana

*New Orleans Aero Club* and The Louisiana Wing of the Civil Air Patrol held their 7th Annual Gulf States Model Airplane Meet on August 2 and 3. Events included Exhibition Scale, Stick and Cabin Endurance, Hand Launched Gliders, Free Flight Gas (Classes A, B, and C), Control Line Speed (Classes 1 through 6), Beauty, Team, and Stunt.

### New Jersey

A gas powered model entered in the Eastern States Championships by Roge Quinlan of Montreal, Canada took off from Teterboro Airport on June 22 at 4:30 p.m. and was found in Danbury, Conn. the next day. This distance is 65 miles and the flight was thought to be the longest ever made by a model plane.

* *

Joe Bligh of *Atlantic City Sky Blazers* sent in the following new slate of officers for the second half of 1947: Pres. Thomas Wrigley; Vice Pres. Richard Sykes; Sec'y. John Manning; Treas. Charley Wills; Sgt. at Arms John Majane. Robert McCurdy remains as Advisor. The Contest Com-

mittee consists of John Manning, John Ginnetti and Joseph Bligh. The Photography Committee: Andy Trechock and Joseph Bligh. The Flying Field Committee: Richard Sykes and Frank Camarota.

Results of the 2nd Annual Atlantic City Control-Line Model Airplane Championships held on May 4 under sponsorship of Lt. J. Willis Gale Post 215, V.F.W., and the sanction of AMA, were as follows:

Class C Speed—1. Alan Ryder 2. Henry Laureys 3. Peter Bandarowere.
Class B Speed—1. Ray O'Neill 2. Willard Hartman 3. M. L. Redman.
Class A Speed—1. John Sellers 2. Fran McElwee 3. Charles Weichard.
Stunt Event—1. Leon Shulman 2. Fran McElwee 3. Richard Hendricks.
Scale Event—1. Ray O'Neill 2. Henry Doré 3. Mike Capik.
High Point Winner—1. Ray O'Neill.

* *

*Passaic Rubber Heels* held their Second Annual North Jersey Model Airplane Championship Contest at the old Delawanna Airport on July 13. This contest featured all types and classes of rubber powered models and gliders. Results will be published when received.

**New Mexico**

The Artesia chapter of NAA sponsored a model airplane contest and show in Artesia on May 24.

**New York**

The Exchange Club of Buffalo sponsored the Western New York Model Airplane Championships at Williamsville on July 27. Results of this AMA sanctioned meet will be published when received.

* *

The New York City Department of Parks opened a control line model airplane flying site at Flushing Meadow Park on June 28. AMA safety rules are enforced, and AMA representatives who are members of the Metropolitan Hobby Guild are in attendance weekends to judge attempts for national records.

* *

Donald L. Seidenspinner, Chairman of the Publicity Committee, sent in the results of the recent election of officers of the *Long Island Model Flyers* of Oceanside: Pres. Ernst Pfeffer; Vice Pres. Ralph Seidenspinner; Sec'y. Bob Kress; Treas. Donald Seidenspinner; Sergeant at Arms George Harris; Chairman of Membership Committee Frank Kurtz, with committee members Jack Smith and Joe Ferns.

* *

Listed below are the results of The Long Island Invitational Championships held at Hicksville, L.I. on June 15 by the *Screamin' Demons* of Hempstead. This was a free flight AAA Contest.

Class A—1. Carl F. Birkel 2. Kenneth Fisher 3. Ralph N. Jackson.
Class B—1. Frank Atzert 2. Gunnar Erickson 3. Edward Soltis.
Class C—1. Irwin Wallman 2. Edward Beshar 3. Jerry Newgarde.

**North Carolina**

Walter B. Thomas Jr., Contest Director, sent in the following results of the Second Annual North Carolina Free Flight Championship held at High Point on June 8 by the *High Point Model Masters.*

*Junior-Senior Combined*

Class A—1. Eugene Parsons 2. Eugene Barnhardt 3. Joe Mickey.
Class B—1. Joe Mickey 2. Arthur Deal 3. James Morefield.
Class C—1. Joe Mickey 2. Fred Covington 3. Bill Garner.

*Open*

Class A—1. Forrest Linthicum 2. Bill Barnhardt 3. R. A. Hull.
Class B—1. Jimmy Kilgore 2. Forrest Linthicum 3. Ben Hammer.
Class C—1. John Ritchie 2. Lester Ritchie 3. Jimmy Kilgore.
Appearance—1. Lester Ritchie 2. Charles E. Pfoertner 3. Paul Marchal.

Longest Flight—1. Forrest Linthicum 2. John Ritchie 3. Bill Barnhardt.
Carter Allen Trophy—1. Forrest Linthicum.

### Oregon

*Salem Cloud Chasers* held a U-Control Contest on June 22 with the following results:

Class D Speed—1. Charles E. Hollinger 2. Jack Hudspeth 3. John Loval.
Class C Speed—1. Gerald Thomas 2. R. D. Smith 3. N. Wilson.
Class B Speed—1. Harvy Jensen 2. Chuck Hollinger 3. Lynn Johnson.
Class A Speed—1. Henry Cole 2. Charles Hollinger 3. R. D. Smith.
Stunt—1. Frank Motely 2. J. Hudspeth 3. D. Hudspeth.
Scale—1. Wilson 2. Suyton 3. Fair.

### Pennsylvania

Phil Heller wrote in to announce formation of a new club, *The Allentown Skyblazers.* Meetings are held every Thursday at 8:30 at the Lyric Hobby Shop, 27 N. 6th St. Officers are: Pres. Robert J. Hartlieb, Jr., Vice Pres. Phillip S. Heller; Sec'y. Herman Bechk; Treas. Homer Summons. A local meet was held July 20 at Convair Airport, sponsored by the Plymouth Motor Corp. of Allentown. Events included control line gas, free flight gas, rubber, and hand launched gliders.

* *

The Norristown Exchange Club has received sanction for its First Gas Model Meet to be held September 21 at Wings Field Airport Inc., 5 miles east of Norristown on Stenton Avenue at "Five Points" at 9:30 a.m. W. Nolan Leonard, Contest Director, may be reached at 825 DeKalb St.

### Tennessee

The Second Annual Upper Cumberland Model Airplane Contest was held August 3 at Crossville. Roy A. Stone was Contest Director, and the event was sponsored by Chronicle Publishing Co. and Trade-A-Plane Service.

### Virginia

*Brain Busters Model Club* of Hampton will hold their Hydro Nationals and Eastern Free Flight Championships on October 5 at Langley Field. This will be an AAAA-AMA sanctioned contest; further information may be secured from Charles Folk, 315 Cottonwood Ave.

### Canada

*Vancouver Gas Model Club* of Vancouver, B.C. will hold their Annual International Gas Model Meet on August 31 and September 1 for U-Control and Free Flight respectively. Events on August 31 will include Scale, Speed (Classes 2, 3, 5 and 6), and Stunt (Junior and Senior). On September 1: Classes A, B and C (Junior and Senior) and Scale. David B. Leaney, Publicity Chairman, expressed the hope that many visitors from the neighboring Northwest states will participate as they have done in the past. Mr. Leaney can be reached at 275 W. 23rd Ave., Vancouver, B.C.

### England

G.M.F. Hemsworth of *Wolverhampton Model Aeronautical Society* sent in the following report of their activities in May and June. On May 10 ten of the members were invited to give a general model flying display at the Wolverhampton Aero Club. On May 11 they held a competition between club members with these results:

Glider Event—1. E. Thompson 2. W. A. Griffiths 3. D. V. Bate.
Open Rubber—1. W. R. Ormerod 2. S. Ward 3. H. Dolan.
Open Power—1. E. Hickman 2. Mick Smith 3. T. Guy.

The following officers were elected on June 11—Chairman Mick Smith (re-elected); Sec'y. S. Ward (re-elected); Treas. W. R. Ormerod (re-elected); Press Sec'y. G.M.F. Hemsworth; and Records Sec'y. Miss Betty D. Pike.

* *

The S.M.A.E. Council threw open the S.M.A.E. Nationals at Gravesend Aerodrome, Whitsuntide 1947 to all affiliated A.B.A. Clubs and to all fully paid up members of the A.B.A. on the same terms as those applying to Clubs affiliated to the S.M.A.E. and to S.M.A.E. Country Members.

### Holland

H.M.H. Hoffman, Regentesselasn 125, The Hague, sent in news of the first big contest in Holland on May 15. To eliminate the matter of luck, logarithms of every time were taken in seconds. For a flight of 100 seconds, contestants received 2 points; for a flight of 600 seconds, contestants received 2.77815 points. Every contestant who had a total in three flights of 5.4 points will be allowed to compete for the Championships in August.

## West Coast Tips

(*Continued from page* 34)

the chances are, if Bob Keech were transplanted anywhere else, or if Don Gulotta or Ed Lansberg or Jack Gilroy (the four finalists) were located anywhere else except on the coast, they would be the equivalent of National heroes in their community, at least as far as model building goes.

In the afternoon, the following flight pattern was flown by the four finalists:

| | Pts. | |
|---|---|---|
| Starting—1 minute | 5 | |
| Takeoff | 1- 3- 5 | (poor, medium, good) |
| 3 consecutive inside loops | | 5 for each good loop |
| 3 consecutive outside loops | | 5 for each good loop |
| Inverted flight, 2 laps (under 6 feet is average, below 3 feet is good) | 3- 7-10 | 3 for good first lap<br>7 for 2 good laps<br>10 for 2 good laps and good recovery |
| 3 horizontal eights | | 25 for first<br>5 each additional |
| Inverted balloon busting, 1-pass | 25 | |
| Upright balloon busting, 1-pass | 15 | |
| Inside square loop | 10-18-25 | 10 below par but with 2 right angle turns in succession<br>18 about average or 3 right angle turns in succession<br>25 all four corners right angle |
| Overhead eights | 15-25-35 | (poor, medium, good) |
| Pair of spectacles | 25-35-50 | (poor, medium, good) |
| 3 vertical eights | | 50 for first one, 25 each additional |
| Outside square loop | 25-35-50 | same grading as inside square loop |
| Landing | 3- 7-10 | (poor, medium, good) |
| Flight pattern | | 25 if stay on pattern |

As you can see, the above pattern is not for the beginner. These boys flew under terrific handicaps in the run-off because the weather was not favorable. The wind was blowing 15 to 25 mph in gusts during the run-off period, and when a man went upside down it was easy to see that a small misjudgment of the wind constituted a major threat to the model. Their efforts are to be praised for the skill with which they counteracted the wind and still managed to put up superior performances. Keech and Gilroy wrecked their planes in the run-off when it looked like the final score was going to be a four-way tie, so although Lansberg and Gulotta actually

represent the West, believe us when we tell you that all four could easily have made the team.

LAST RUSH RESULTS on the finals at Alameda June 15, East-West Championship: Results are incomplete, as we were unable to attend the meet due to transportation difficulties. From what the boys tell us, it was a smash-bang meet, and the Northerners really outdid themselves in their hospitality. When the Southern team arrived at the station they were met by members of the Alameda Chamber of Commerce anad the Northern Aero-Modelers Ass'n and were, without any further ado, introduced to and placed in homes of those public-minded people who had volunteered their homes for the boys during their stay. This is truly indicative of the close cooperation and good sportsmanship that graced the entire proceedings from start to finish. Not only did the Northern boys furnish places for them to stay, but they dined them at a banquet and really outdid themselves in preparation for the meet. There were even hydraulic lifts that were raised 10 ft. in the air on which two judges sat to gauge the distances that the men were flying above the ground so there could be no mistake.

No contestants were allowed to speak to a judge during the contest, and in case of a protest there was a special table where a modeler could make his protest. If the protest was warranted a judge would come to the table, but the contestant was not allowed to talk to them during the contest.

A lot of credit is due Dr. W. C. (Buzz) Darnell of Glendale who did a nice job in getting the boys lined up for the meet; he and his wife chaperoned the boys to and from Alameda.

At this hour we do not have a complete list of all team members who will make the St. Louis trip. (See "Club News" for final results.)

Here are the rules that the finals for the East-West meet were run off under in Alameda on June 15 for the West Coast:

### CONTEST RULES FOR AEROBATIC EVENTS SO. CALIFORNIA MODEL CONGRESS

*1. Contestants:* Anyone, whether a member of a club or not, is eligible to enter these contests.

*2. Rules:* Contestants agree to abide by these rules, conditions, and regulations, as well as any amended or additional rules announced by the judges. Any contestant failing to abide by the rules may be disqualified. The decision of the judges is final.

*3. Waiver:* By enterting these contests, contestant agrees to waive any claim for damages which may arise in conjunction with these contests, against any city or County, Park Commission, Recreation Department, Junior Chamber of Commerce, School Board, or any member thereof, or any club sponsoring the contest.

*4. Protests:* All protests must be submitted, in writing, to the Contest Committee not later than 30 mins. after the incident in question has taken place.

*5. Builder of the Model:* Entrant must be builder and flyer. If an airplane is built by a group, it must be entered in the senior event as a group entry, providing the pilot is over ten years of age.

*6. Safety Committee:* Each model will be inspected before being allowed to fly. Models not meeting approval will not be allowed to fly until the defect is corrected.

*7. Number of Models:* Any number of models may be entered. Each contestant may be entered only once in each event.

*8. Number of Flights:* Not to exceed three attempts to make two official flights. The Club may reserve the right to make it only two attempts to make one official flight if circumstances make this necessary.

*9. Flights:* Flights over five minutes duration will lose landing and flight pattern points. Flights over six minutes will be disqualified.

*10. Entry Fee:* Fifty cents for each model entered in each event.

*11. Starting:* Three minutes are allowed for starting. Failure to do so will constitute one attempt. Multi-motored ships will be allowed three minutes for the first motor and three minutes for each additional motor.

*12. Engines:* Engines must be internal combustion reciprocating type.

#### Flight Rules

*1. Engine Classes:*

Class A .001 30. Multi-engined models will take the class.

Class B .301 50 of the largest engine in model.
Class C .501 65.

*2. Lines*—Must be steel and stand fifteen gs test, maximum length 70 ft.

| | Maximum Points |
|---|---|
| 3. *Points for precision flight:* | |
| a. Starting: Plane taking off within 1 min. of starting time .............. | 5 |
| b. Take-off: Sloppy—1, rough—3, smooth—5 .............. | 5 |
| c. Level Flying: (Approx. 6' alt.—2 laps) Rough—1, wavy—3, smooth—5 .............. | 5 |
| d. Climb: (Should be at least 15' vertical) Shallow—3, steep—7, vertical—10 .............. | 10 |
| e. Dive: (Should be at least 15' vertical) Shallow—3, steep—7, vertical—10 .............. | 10 |
| f. Wing-over: (Vertical climb and dive passing directly over pilot's head and cutting the ground circle in half) Poor—5, fair—10, excellent—15 ... | 15 |
| g. Inside Loops: (Consecutive) One—3, two—7, three—12, four—18, five— Loops must be done within a quarter of a lap and must not exceed an altitude formed by an acute 60 degree angle between the ground and the control wires. | 25 |
| h. Inverted Flight: Must start and end in normal right side up position and laps must be in opposite direction to take-off and landing. One lap 10, second lap 10, recovery to normal flight attitude 10. Total 30 maximum | 30 |
| i. Outside Loops: (Consecutive) 1st one counts 25 points. Each additional one counts 5 pts. each. Maximum of 5 loops is 45. Loops must be done within a quarter of a lap and must not exceed an altitude formed by an acute 60 degree angle between the ground and control wires. May be started inverted or upright, but complete loops must be made .............. | 45 |
| j. Horizontal Figure Eight: Must be done within ½ lap. First one counts 25 points. Each additional one counts 5 points each; maximum of 3 horizontal figure eights is 35 points. Wires not to exceed 60° angle ...... | 35 |
| k. Vertical Eight: Wires not to exceed 90° elevation .............. | 30 |
| l. Overhead Eight: The crossing point of the eight is directly over the pilot's head. Wires not below 30° .............. | 30 |
| m. Square Loop: Ship must remain in level flight ¼ lap .............. | 30 |
| n. Special Maneuvers. Must be described on entry blank .............. | 30 |
| o. Landing: Nose-over 1, rough 3, bounce 7, smooth 10 .............. | 10 |
| p. Flight Pattern: Contestant must choose his own pattern of any or all of the above maneuvers. Choosing a maneuver and faling to attempt to do it will lose flight pattern points, with the exception of it being a crash, a sour motor run, or motor failure. A crash or motor failure during a maneuver will not void the point already made from that specific maneuver up to the time of the crash. Judging will be done only the first time that a maneuver is attempted or accomplished. Contestant may use as many laps as desired for warm-ups and testing. When ready to start stunts, a signal must be given the judges. Dive, climb, and wing-over must individually start and end in normal horizontal flying attitude. There must be at least one level lap between each maneuver .............. | 25 |
| 4. *Appearance Rating:* Points for appearance will be alloted on the following basis: a. Design 10, b. Finish 15, c. Workmanship 25. Points accumulated for flying and appearance will be added .............. | 50 |

## Cockpit Radio Control

(*Continued from page 24*)

that shown in Fig. 12. When this has been perfected, the necessary parts can be added to develop a full-blown "wheatfield."

This article would not be complete without a few words of grateful acknowledgment to the people who helped us in our radio control experiments, and particularly to: Bob Stoneman, who worked with us constantly; Ed Schunke, who entrusted us with a twin cylinder engine of his own design and construction to give our ship the extra power it needed; our "hams," Bob Schmidt and Keith Hayes; the local model supply dealers who aided us in getting unusual parts in a hurry; and our long-suffering mother, who usually found her kitchen turned into a radio lab just as she wanted to do an important piece of cooking.

And to our readers who are doing experimental work with our favorite toy—we hope you've got everything under control!

## Heart of Your Plane

*(Continued from page 13)*

for (D) and 3.1416 for ($\pi$), we have a slip value of 1.93 inches. This means that the theoretical propeller pitch must be the actual pitch of 6" plus 1.93" or 7.93". Your prop must be cut so that the blade is at the angle that provides a pitch of 7.93".

Fig. 2 shows the end of the block ABCD from which your prop is to be cut. The diagonal from A to C represents the angle of the blade at the tip. The face of the blade AB is extended to represent the sideways travel of a prop blade in one revolution. This is equal to the circumference of the circle, or $\pi$ times the diameter. With a 10" propeller this will be 31.416. Line AC extended to $C^1$ represents the actual distance along the spiral path traveled by the blade tip in one revolution. Consequently, the distance from $B^1$ to $C^1$ is the *theoretical* propeller pitch. The actual pitch or distance traveled forward in one revolution is the distance $B^1C_2$ because the line $AC_2$ is the actual path traveled by the prop blade tip when acting at an attack angle of 3-1/2° as shown on the diagram. So we see that this distance $B^1C_2$ is equal to the airplane speed divided by the engine rpm while distance $C_2C^1$ is equal to the slip, $\frac{\theta \pi D}{57} = 1.93''$.

Some readers may feel this is too technical to bother with. They would rather guess at their propeller pitch. Many of these are the fellows who go to contests

and fail to carry home the hardware, especially if they are poor guessers. It is not difficult to apply these facts to the design of your prop, especially if they are props for control line speed flying. All you have to do is to figure the flight speed at which you expect or want your airplane to fly. For example, suppose you believe your plane will fly over 100 mph and you wish to attain the speed of 120. First you determine the number of maximum revolutions of your engine; say this is 10,000. Merely divide 10,000 rpm into 120 times 1056. The value 1056 is a numerical constant which converts 120 mph into inches per minute. The answer is 12.67 inches. This represents the actual pitch of your prop in inches. To give maximum efficiency, a value of

$$\left(\frac{(3.5)\ (3.1416)\ D}{57}\right)$$

must be added to the actual pitch. If the prop is 10" in diameter, this gives a total prop pitch value of $1.93 + 12.67 = 14.60''$.

In free flight models the problem is not quite so simple because the propeller is to be designed for the climbing flight speed, unless the model has a rate of climb which is very small. In such cases the climbing flight speed is approximately the same as the minimum level flight speed indicated by Fig. 3. Level flight is $V_{LF}$. The climbing flight speed is $V_{CF}$. The actual rate of climb then is represented by the vertical line $V_C$. The correct propeller pitch can therefore be determined if the minimum level flight speed is known. This may be calculated by knowing the airplane weight, total wing area, and the camber factor. The camber factor is the value which is proportional to the lift coefficient of the airfoil at level flight angle of incidence and is calculated by the following formula: $C_F = \frac{(3\,H_U + H_B)}{4\,C}$

In the formula $C_F$ is the camber factor; $H_U$ the maximum height of the upper airfoil curve above the chord line; $H_B$ the height of the lower surface curve above or below the chord line. If this curve is above the chord, $H_B$ is positive; if below the chord, as in convex lower surface airfoils, it has minus value and should be inserted in the formula as $-H_B$. The value C represents length of the wing chord. All these values are in inches. For the Grant X section, for instance, the camber factor is .0885, so the minimum *level flight* velocity formula may be written:

$$V_{LF} = 21.1\sqrt{\frac{W}{A\ (C_F)}}$$

$V_{LF}$ = miles per hour. To determine $V_{LF}$ in inches per minute, multiply it by 1056. Then the formula is:

$$V_{LF} = 22{,}282\sqrt{\frac{W}{A\ (C_F)}}$$

In the formula, W equals airplane weight in ounces; A is wing area in sq. in. and $C_F$ is the camber factor. Taking as an example a well known airplane, the "KG," minimum level flight speed is calculated as follows:

$$V_{LF} = 21.1\sqrt{\frac{104}{1382\ (.0885)}} = 21.1\sqrt{\frac{.0752}{.0885}} = 19.4 \text{ mph.}$$

or, $V_{LF} = (19.4)\ 88 = 1708$ feet per min.

The actual flight speed and the climbing flight speed is 19.4 mph. To determine the propeller pitch, this value is converted into inches per minute by multiplying 19.4 by (1056) or (1708) by (12) = 20500 in. per min., then dividing by the number of engine rpm, and finally adding the slip value to this. If you have no time or are not inclined to calculate this value, a short, average and approximate value can be obtained by making the prop pitch 70% greater than the flight speed divided by the rpm of the engine, for low rates of climb. In other words, divide the flight speed by the rpm and multiply it by (1.7). For the approximate propeller pitch for average models that have a medium rate of climb (26 mph), multiply by 1.60: and by 1.5 for models with a very high rate of climb.

The problem is more difficult, however, for models with very high rates of climb, planes which climb at 30, 45 or more degrees like modern high performance contest planes. These planes which are very powerful relative to their weight, have a climbing flight speed far exceeding their minimum level flight speed. An approximate formula for this type of model can be determined as follows: first determine the rate of climb represented by the vertical line $V_C$ in Fig. 4. A simple formula for this, and one that has been tested is:

$$V_C = \frac{1.625}{C_F}\left(\frac{C_U\ (R.P.M.)}{W} - 13.5\right)$$

= Rate of climb in feet per min.
($C_U$ = piston displacement in cu. in.)

The problem is to determine the value of the climbing flight speed $V_{CF}$. The line $V_{LF}$, Fig. 4, represents the minimum level flight speed, which in the average model is 1800 ft. per min.—approximately 20 mph when the minimum allowable wing loading is used. This is 7 oz. for every 100 sq. in. of wing area. If the wing loading is greater—8 oz. for instance, the level flight speed will be 1/7 greater than 1800 ft. per minute. The value of $V_{CF}$ is equal to the square root of the sum of $V_C$ squared, plus $V_{LF}$ squared, and may be written as a formula:

$$V_{CF} = \sqrt{(V_C)^2 + 3{,}240{,}000}$$

When substituting the values of an average high powered contest model in the formula, it is worked out as follows:

$$V_C = \frac{1.625}{.0777}\left(\frac{2\ (10000)}{17} - 13.5\right), \text{ or, } V_C = 20.9\ (104), \text{ or,}$$

$V_C = 2176$ ft. per. min. (Rate of climb). Then,

$$V_{CF} = \sqrt{(2176)^2 + 3{,}240{,}000}, = \sqrt{7{,}980{,}000}$$

or, $V_{CF} = 2820$ ft. per min. (climbing flight speed).

$$\text{or, } V_{CF} = 32 \text{ mph. } \left(\frac{2820}{88} = 32\right)$$

Knowing the velocity of the airplane when climbing, the proper pitch to give

your prop is determined in a manner similar to the examples on previous pages. That is, the velocity of climbing flight in feet per minute is divided by engine rpm and multiplied by 12 to obtain a value in inches per minute. To this is added the value of the slip as follows:

$$P_P = \left(\frac{\theta\pi D}{57}\right) + \left(\frac{12\ (V_{CF})}{R.P.M.}\right), =$$

$$\left(\frac{3.5\ (3.1416)\ 10}{57}\right) + \left(\frac{12\ (2820)}{10{,}000}\right),$$

or, $P_P = (1.93) + (3.38) = 5.31$ inches, (propeller pitch).

$$P_P = 5.31 \text{ inches.}$$

This method gives an approximate value for propeller pitch that will be very close to the actual value. However, if you wish to be more accurate, the following formula will give the rate of climb $V_C$, and the climbing flight velocity $V_{CF}$, for any model whether or not it has high power compared to its weight:

$$V_C = (.1134)\left(\frac{C_U\ (R.P.M.)\ A}{W^2 C_F}\right) - \left(\frac{1.915}{(C_F)^2}\sqrt{\frac{W}{AC_F}}\right), \text{ or,}$$

$V_C = 2305 - 311$, or $V_C = 1994$ ft. per. min.

Then, $$V_{CF} = \sqrt{V_C^2 + \left(1856\sqrt{\frac{W}{AC_F}}\right)^2}, \text{ or,}$$

$$V_{CF} = \sqrt{(1994)^2 + \left(1856\sqrt{\frac{17}{228\ (.0777)}}\right)^2},$$

$$= \sqrt{(1994)^2 + [1856(.98)]^2},$$

or,

$$V_{CF} = \sqrt{3{,}980{,}000 + 3{,}315{,}000}, = \sqrt{7{,}295{,}000},$$

or, $V_{CF} = 2700$ ft. per. min. (climbing flight speed).

$$\text{Propeller pitch, } P_P = \left(\frac{\theta\pi D}{57}\right) + \frac{12\ (V_{CF})}{(R.P.M.)},$$

$$\text{or, } P_P = \frac{3.5\ (3.1416)\ 10}{57} + \frac{12\ (2700)}{10{,}000}, = (1.93 + 3.2),$$

or, $P_P = 5.13$ inches.

Many modelers are afraid of formulas, but here all that is required is a knowledge of simple arithmetic and a little patience. The result in improved performance for your model will be well worth the little trouble required to carry through these calculations. After all, they are no more difficult than crossword puzzles and serve a much more useful purpose.

You will note that in the process of calculation, you not only determine the correct pitch of the propeller but you also find the rate of climb, a figure often helpful to many model builders. The angle of climb can also be determined by plotting the climbing flight velocity, the rate of climb and the level flight velocity in the form of a triangle, as in Fig. 4. Angle $A_C$ is the angle of climb. It can be measured or calculated. If you are not adverse to simple trigonometric notations, it is written: $A_C$ = the angle whose Tan =

$$\frac{V_C}{V_{LF}} = \frac{2176}{1800}$$

Insert the values for $V_C$ and $V_{LF}$ as shown and divide. Look this value up in a trigonometric table which will show the value of angle $A_C$, when the tangent is the numerical value given: $A_C = 56°$.

## Current Saving Ignition System

(*Continued from page 32*)

tory for starting purposes. If the engine stops when the plug-in cell is pulled out and while the rheostat is full on, and tests show that current is getting to the timer, it indicates that the model cell is too weak to keep the engine running and should be replaced.

The plug-in and model cells should approximately match each other in amperage tests for most economical results. Otherwise the stronger cell is weakened by forcing current through the weaker cell. The plug-in cell rack is made to hold two cells that are run down (to 2 amps. for instance) and they are connected in *parallel* to match a stronger model cell (in this instance 4 amps.). Thus substantially all the useful life of each cell is used down to approximately 1-1/2 amp., which is about the minimum possible for running purposes. Also, cells run down to this point will recuperate somewhat if given a day's "rest" and can be recharged, or more accurately "reactivated" as described in MODEL AIRPLANE NEWS, Nov. 1944, page 31. When rest and reactivation no longer produce results, the cell still has some life left for flashlight or model lighting purposes.

If you wish to use only one cell in the plug-in rack, as when its amperage matches that of the model cell, place a second cell in the rack for balance but insulate it from the contact strip by inserting a piece of insulation or paper between the brass cap on the carbon electrode at the center and the contact strip.

The series plug-in arrangement has been found, when two or three extra pairs of cells are carried in the kit, to be quite ample for a day's flying. The weight and expense of that many cells is not great, and of course some of the cells can be used later after recuperation or reactivation.

While the plug-in arrangement described is satisfactory for size D flashlight cells, it is less so for medium and "pen" cells unless a particularly efficient spark coil is used. However, model planes of 24" span and over can nicely carry one size D cell, the weight of which is only 1-1/2 to 2 oz. greater than two pen cells. At the same time the large cell has many times more volume and proportionally greater capacity and longer life.

The rheostat is useful with or without the plug-in cell arrangement and is especially good as a timer point, sparkplug point and current saver for the miniature storage cells that are now on the market. The makers of such storage cells have recently developed a 2 volt spark coil which, on paper, would seem to be even more adaptable to the above described ignition system.

### HOW TO SCALE UP PLANS

Many readers have difficulty in enlarging plans of models, or 3 Views of big ships. There are many excellent ways of enlarging—Pete Bowers, a model builder of long experience, will explain the various methods in the

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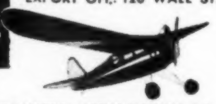

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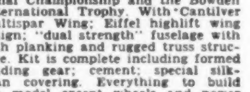

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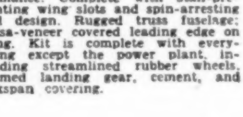

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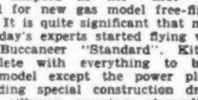

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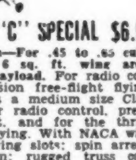

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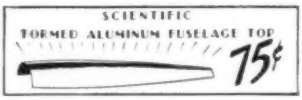


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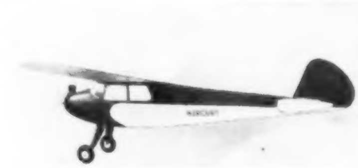

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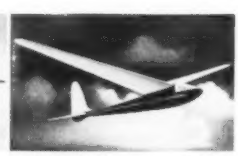
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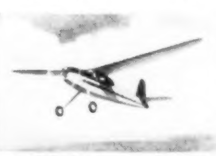
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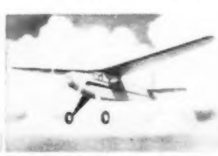
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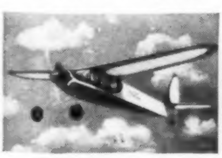
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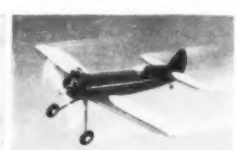
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